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BY THE U.S. GENERAL ACCOUNTING OFFICE

Report To The Chairman, Subcommittee On Fossil And Synthetic Fuels Committee On Energy And Commerce House Of Representatives

Removing Barriers To The Market Penetration Of Methanol Fuels

This study examines some of the impediments confronting the development of methanol as a commercially viable transportation fuel. The primary barriers confronting methanol commercialization are economic, and they are largely dependent on the price of competing fuels.

There is little the Federal Government can do to influence these economic factors short of providing financial incentives. However, certain Federal regulations may present additional, though less substantial, impediments. Unlike the economic barriers, regulatory factors are within the control of the Federal Government. GAO believes that certain other measures might be effective at the margin--that is, they would not in themselves create widespread use of or demand for methanol, but they might help.

In the short term, the development of a market for methanol fuel may not reduce U.S. reliance on imported energy because low priced foreign methanol is becoming available. This factor is relevant to any decision to promote methanol for national security reasons.

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RESOURCES COMMUNITY,
AND ECONOMIC DEVELOPMENT
DIVISION

B-207090

The Honorable Philip R. Sharp
Chairman, Subcommittee on Fossil
and Synthetic Fuels
Committee on Energy and Commerce
House of Representatives

Dear Mr. Chairman:

In your letter of April 28, 1982, you asked that we identify and assess infrastructural and institutional barriers to methanol's market penetration as a transportation fuel and examine policy options available to the U.S. Government to overcome these barriers. This report responds to your request.

As arranged with your office, we are sending copies of this report to the Senate Committee on Energy and Natural Resources, the House Committee on Energy and Commerce, and other interested parties. We are also sending copies to the Departments of the Treasury, Transportation, and Energy; General Services Administration; and the Environmental Protection Agency. It will also be available to others upon request.

Sincerely yours,

J. Dexter Peach
Director

GENERAL ACCOUNTING OFFICE
REPORT TO THE CHAIRMAN,
SUBCOMMITTEE ON FOSSIL AND
SYNTHETIC FUELS, COMMITTEE
ON ENERGY AND COMMERCE
HOUSE OF REPRESENTATIVES

REMOVING BARRIERS TO THE MARKET PENETRATION OF METHANOL FUELS

D I G E S T

Methanol (or methyl alcohol) is a liquid that can be used as a fuel in itself or blended with gasoline or diesel fuel to run an automobile or other vehicle. It can be derived from natural gas, coal, wood, and other renewable sources. Some authorities expect methanol to become the preferred alternative fuel of the future because it offers the prospect of decreasing U.S. dependence on imported oil; others point to methanol's inherent energy efficiency. Use of methanol as a transportation fuel seems to be technically feasible although some uncertainties remain. Nevertheless, methanol has not emerged as a major transportation fuel because large investments are necessary to bring sufficient fuel and vehicles to the national retail level, while prospective return on investment has, to date, been inadequate to convince fuel producers and auto manufacturers to enter the market.

The Chairman of the Subcommittee on Fossil and Synthetic Fuels, House Committee on Energy and Commerce, asked GAO to identify and assess the barriers to methanol's market penetration as a transportation fuel and suggest possible Government actions, short of expensive subsidies, which might eliminate or diminish market impediments. This report suggests several actions that the Federal Government could take to accomplish that objective.

ECONOMIC BARRIERS TO WIDESPREAD USE OF METHANOL

Using methanol as a fuel in itself or as a substantial portion of a blend to power automobiles and other vehicles requires two conditions--the production and availability of methanol itself and the existence of vehicles designed to use it. The principal barrier is the economics of producing and distributing both the fuel and the vehicles. Such an undertaking involves complex and costly operations; it raises the "chicken or the egg" question of which comes first.

Auto manufacturers are unwilling to produce cars designed to run on methanol fuels until the fuel is widely available at the retail level. Methanol producers and marketers are unwilling to invest in a fuel that has as yet few customers. In the absence of a clear demand for the products, neither side is likely to invest significant amounts of capital to develop this alternative-fuel source. (See p. 7.)

FEDERAL STANDARDS AND REGULATIONS AFFECTING METHANOL

Besides economic considerations, various Federal standards and regulations affect methanol fuels and vehicles that use them. To promote the use of methanol as an alternative transportation fuel, the Government could take several steps to overcome or diminish administrative impediments. Keeping in mind the fundamental economic barriers which must be overcome, GAO considers that these steps might be effective at the margin--that is, they themselves would not create widespread use of or demand for methanol fuels or vehicles, but they might help. (See p. 10.)

Emissions standards

Currently, the Environmental Protection Agency (EPA) regulates methanol's use in blends with unleaded gasoline. In order to be approved, blends must be tested to assure that they will not cause vehicles to violate established emission standards. Some fuel manufacturers have complained about the need to test each individual blend because this process is costly and time consuming. If possible, EPA could provide a blanket waiver for blends within certain limits, which would eliminate the need for individual testing in many cases. This may require the manufacturers to make public more information about the formulation of their blends. (See p. 10.)

Methanol when used as a fuel emits significantly higher levels of aldehydes (suspected carcinogens) than gasoline or diesel fuels. It also results in emission of unburned methanol. EPA could help in reducing some of the market uncertainty by developing appropriate emission standards in anticipation of market development--that is, before widespread methanol use makes their need apparent.

Fuel economy standards

GAO found that there is no officially accepted method of comparing the fuel economy of methanol fuels with that of gasoline or diesel fuels under the Corporate Average Fuel Economy Standards. This comparison is not straight forward because methanol and gasoline contain different amounts of energy per unit of volume. The inability to compare the economy of the two types of fuels would probably have a negative effect on both the production and sale of vehicles using methanol. However, EPA, with the cooperation of the Department of Transportation, may be able to establish an equivalency factor to compensate for methanol's lower volumetric energy content compared to established fuels. Both the mechanism and the precedent have been set to take this action. (See p. 17.)

Methanol in commerce

Although methanol has been safely handled for many years as a chemical commodity, no standards or regulations exist for the orderly commerce--production, storage, and use--of methanol as a fuel. The absence of these standards may add to investors' uncertainty and cause delays in market development. To encourage orderly commerce in methanol, the Government may be able to cooperate with the American Society for Testing and Materials and similar organizations to develop appropriate criteria. In dealing with similar materials, the General Services Administration and the Department of the Army have established precedents for setting standards which have subsequently been adapted for private industry. (See p. 20.)

Antitrust considerations

GAO's study revealed that antitrust considerations may limit some specific cooperative activities considered desirable by methanol fuel producers and vehicle manufacturers. Vehicle manufacturers and methanol producers would like to agree on standards and production schedules to assure simultaneous availability of both vehicles and fuel. The scope, extent, and duration of vehicle and fuel producers' cooperation could be defined in consultation with the Department of Justice to minimize the chance of formal antitrust actions. Procedures for such consultations are well established. (See p. 22.)

PUBLIC AND PRIVATE FLEET USE OF METHANOL VEHICLES

GAO examined the potential for using methanol in large public and private fleets as a market catalyst. This potential is limited by technical constraints and the driving requirements of many fleets. Under favorable conditions and assuming some motivation on the part of fleet operators to convert, captive fleet use of methanol could potentially lead to a wider market for methanol fuel and vehicles. This development would be further encouraged if fleet operators were to contract for their fuel needs with gas stations open to the general public rather than service their vehicles in private facilities.

Converting the Federal fleet to methanol fuels might have a positive psychological effect by indicating a Government endorsement of methanol. GAO believes, however, that such action by itself would not provide a sufficient market to promote general availability of methanol fuel and vehicles. (See p. 26.)

METHANOL IMPORTS MAY PENETRATE DOMESTIC MARKET

If a market for methanol develops in the transportation sector, fuel supplies beyond current production capacity may not come from new domestic sources but may be imported. Producing methanol from domestic coal is unlikely in the near- to mid-term because of the large front-end capital investment required for this type of production facility and the likelihood of price competition from imported sources. Domestic methanol from natural gas may also be vulnerable to some extent to price competition from imports, especially as natural gas prices in the United States increase. The quantity of methanol currently imported is increasing, but it is still small compared to domestic production. For the future, however, foreign producers of methanol apparently may enjoy a significant price advantage. Their natural gas feedstock, essentially a by-product of crude oil production, is often flared or reinjected. It can therefore serve as the basis for low cost methanol production. (See p. 44.)

AGENCY COMMENTS

The Departments of Energy, Justice, and Transportation; the Environmental Protection Agency;

and the General Services Administration commented upon a draft of this report. These comments are included in appendix III. In general, they agreed with the findings of this report. GAO made certain observations on steps that the Government could take to remove barriers to methanol's commercialization. Agency comments broadly supported these. Editorial suggestions have been incorporated in the report, where appropriate.

The Department of Energy (DOE) made the relevant point that a volumetric tax on methanol as a fuel constitutes a potential barrier to increased methanol use because methanol contains less energy by volume.

DOE gives greater emphasis to potential antitrust problems than does the report. GAO believes that until existing antitrust remedies available through the Department of Justice have been tried, it is too early to conclude that they are inadequate. DOE also took issue with GAO's view that imported methanol may help to meet increased domestic demand from the transportation sector in the near- to mid-term on the grounds that foreign demand may also increase. Potential foreign demand might well increase; GAO did not examine this subject in detail. However, large quantities of natural gas continue to be flared in major foreign oil producing countries. This fact suggests that the potential for natural gas-based methanol production overseas is high. Therefore, increased U.S. demand for methanol fuel may result in larger methanol imports because foreign producers are likely to have access to low cost feedstock and to produce methanol less expensively. Domestic coal-to-methanol production could develop in the longer term.

The Department of Transportation suggested that GAO more extensively address possible safety hazards of methanol fuel use. Methanol fuel use presents several safety related trade-offs compared to gasoline. In the open air, neat methanol (above 85 percent pure) is considered less dangerous than gasoline. On the other hand, as Department of Transportation points out, methanol vapor in a vehicle tank may be an increased fire hazard. Low percentage methanol blends seem to present no special safety hazards. Chapter 2 discusses this issue in greater detail.

The General Services Administration recommended a more extensive discussion of engine and fuel compatibility problems. Chapter 1 of this report notes that methanol fuel may require substantial modifications to existing gasoline vehicle engines and fuel systems. Furthermore, differences in combustion characteristics between methanol and gasoline prevent the use of one of these fuels in a vehicle designed or modified to use the other.

The comments of the Department of Justice and the Environmental Protection Agency are clarifying and have been incorporated.

Information contained in this report was gathered between May and July 1, 1982. It was updated during the spring of 1983.

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ABBREVIATIONS

DOE	Department of Energy
DOT	Department of Transportation
EPA	Environmental Protection Agency
GAO	General Accounting Office
GSA	General Services Administration

CHAPTER 1

INTRODUCTION AND BACKGROUND

METHANOL PRODUCTION AND USE

Methanol production

Methanol (or methyl alcohol) is a liquid which can be derived from natural gas, coal, wood, and other biomass sources. Currently, it is produced primarily from natural gas and is used mainly as a chemical in manufacturing products such as building materials, plastics, and synthetic fibers. The United States produces approximately 1 billion gallons of chemical methanol annually, with 1981 domestic production totaling around 1.3 billion gallons or 85,000 barrels per day. Table 1 presents U.S. domestic methanol production, imports, and end-uses for recent years.

Table 1

U.S. Methanol Production, Imports, and End Uses

(millions of gallons)

	1979	1980	1981
U.S. methanol production	971.8	1077.0	1266.0
Total imports	58.7	35.6	26.5
Imports for fuel purposes	-	.03	.4
End-Uses			
Chemical	1090	980	*
Fuel uses (total)	10	50	*
Octane enhancers	5	30	*
Direct fuel	5	20	*

*not available

Sources: U.S. Census Bureau, U.S. Trade Information Office
1982 Commodity Yearbook
E.I. duPont De Nemours & Co.

Most of the Government and industry analysts we interviewed agree that natural gas is likely to continue to be the major source of methanol in the short term. In the longer term, coal will become the likely domestic source of supply because of its relative abundance in the United States. Evidence indicates that sufficient economically recoverable reserves of coal exist to produce enough methanol to totally replace gasoline for about 100 years and still meet a doubling of current demand for coal for other uses. The technology for producing methanol from coal is proven, plants for converting coal to methanol have been demonstrated, but commercial-sized fuel plants are not yet in

operation in the United States. This is due, at least partially, to their higher capital and operating costs relative to natural gas-based methanol facilities. Despite the higher capital and operating costs, many analysts believe that in the future methanol fuel from coal can also be competitive with gasoline, depending on the future price of oil and other factors.

Methanol production from wood, biomass, and municipal wastes has also been demonstrated, but the cost estimates for commercial-scale production are even more speculative than those for coal-based methanol, and the technology is not so well developed at this time. As a result, the magnitude of the contribution of biomass technologies to methanol fuel supply in the future is uncertain.

Current transportation uses of methanol

Vehicles specially designed or converted to burn "neat"[1] methanol are now used in the United States by a limited number of vehicle fleets and experimental projects. Methanol fuel has also been used for years in certain high-performance racing cars. Methanol blended with gasoline is currently being used both experimentally and commercially in conventional gasoline engines either with or without minor carburetor, engine, or fuel system modifications.

The recent growth of methanol fuel use in the U.S. transportation sector can be attributed to several factors. Since 1979, several fuel companies have obtained waivers from the Environmental Protection Agency (EPA) which permit them to use small percentages of methanol as an octane enhancer in gasoline. Methanol is also being used to produce other chemicals that improve engine performance. Increasing experimentation with higher percentage methanol/gasoline blends and neat methanol is also contributing to the growth of methanol fuel use. Among those conducting experimental fleet test programs are the U.S. Postal Service, the California Energy Commission, the State of Florida, the Los Angeles County Government, the City of Baltimore, Bank of America, and the Fireman's Fund Insurance Company.

Several foreign countries, including Canada, West Germany, Sweden, and New Zealand, are also experimenting with methanol and methanol blends. The motivation for this work comes from the dual objectives of enhancing energy security and finding more environmentally benign fuels.

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[1]Neat methanol, as used here, is actually a blend of 85 percent or greater methanol and additives for lubricity and stability to avoid vapor lock and improve ignition to facilitate engine use.

Federal and State government activities relating to methanol fuel

The United States Government has made a significant contribution to the development of methanol technology. The Department of Energy (DOE), through the Alternative Fuels Utilization Program (AFUP), developed technical data and information. AFUP sponsored research on vehicle operations at the University of Santa Clara, using two generations of technology. This work is directly linked to subsequent development carried out by the State of California, the Ford Motor Company, the U.S. Postal Service, and others. In addition DOE, in conjunction with the Department of Transportation (DOT), has tested the viability of using methanol in certain heavy duty diesel-type engines. EPA has initiated a program designed to analyze the emissions, emissions impact, and energy efficiency of methanol fuel. EPA has to date tested four passenger cars and two heavy-duty engines at the Southwest Research Institute. EPA has also funded contracts with Ford Motor Company and a consulting firm to analyze several methanol engine designs, and it is presently testing several current engines at its Ann Arbor Laboratory to characterize their performance with methanol fuel.

The Government of the State of California has been very active in promoting methanol vehicle fuels. In April 1980, the California State Energy Commission (CEC) adopted a formal resolution in support of alcohol fuels. This resolution endorsed:

--Development of an alcohol fuels program to reduce reliance on imported petroleum.

--Limited near-term use of alcohol/gasoline blends.

--Encouragement and support for long-term transition to neat alcohol fuels.

--Increased alcohol fuel supplies.

--Development of new energy-efficient end-use applications.

Besides fleet testing of methanol blends and neat methanol and vehicles (see ch. 3), the CEC is actively involved in developing new end-use applications for methanol. The Commission is planning a mobile demonstration program focused on the use of methanol in heavy-duty transit engines. Two to three different manufacturers will provide prototype engine/coach combinations for use in actual transit service. These buses are expected to begin service in early 1983.

The CEC is also planning a full-scale commercial demonstration which will require a State investment of $5 million. California also legislatively encourages the use of methanol and methanol vehicles. Among other incentives, a State tax credit for 55 percent of the cost of converting a vehicle to run on neat methanol, up to $1,000, substantially reduces the cost of conversion.

Factors relating to methanol fuel use

Using either "neat" or blended methanol fuel involves a variety of both benefits and costs. Some of these are evident at this stage in development, but others are uncertain and will require additional or extended testing.

Neat methanol as a substitute for gasoline has certain unique benefits. Past experience has shown that methanol can cost about half as much per gallon as gasoline. It contains, however, only about half as much energy by volume. In optimized engines it can burn more cleanly and substantially reduce regulated emissions--carbon monoxide, nitrogen oxide, and hydrocarbons. Methanol can, in addition, increase engine power. Vehicles which are modified to take advantage of the unique qualities of methanol can achieve superior engine performance of at least 15 to 25 percent--and perhaps as high as 100 percent[2]--greater mileage per Btu (British thermal unit[3]) relative to that of gasoline and conventional gasoline engines.

To illustrate the potential technical engine efficiency gains associated with methanol vehicles and what this means in terms of costs and volumes of fuel relative to gasoline vehicles, table 2 compares various hypothetical cases for methanol and gasoline vehicles.

For this comparison, we are assuming that each vehicle has a 22 gallon fuel tank and travels an average of 10,000 miles per year. The assumed cost of fuel is $1.38 per gallon of gasoline and $1.05 and $0.85 per gallon of methanol, including taxes. The assumed State and Federal taxes on both fuels are $0.20/gallon. The costs of both methanol and gasoline have fluctuated recently. The prices used here are for illustration. Table 1 demonstrates that a gasoline vehicle achieving 25 miles per gallon fuel economy would average about 550 miles per 22 gallon tankful of fuel. Traveling 10,000 miles per year, this vehicle would have to refuel 18 times at a total annual cost of roughly $550. A methanol vehicle achieving 13.9 miles per gallon would average about 306

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[2]The Bank of America has stated that it has developed a new low compression technology for converting vehicles to burn methanol. According to Bank of America officials, this technology can achieve close to 100 percent efficiency improvement over the same vehicle running on gasoline. Many experts, however, contend that efficiency gains of this magnitude, especially without modified engine compression ratios, are unusual, based on experiences of other test programs.

[3]A British thermal unit is a measure of energy content denoting the amount of energy required to raise the temperature of a pound of water one degree Fahrenheit.

miles per 22 gallon tank of fuel. The vehicle would have to refuel every 306 miles, and to travel 10,000 miles per year, it would have to refuel 33 times per year at an annual cost of $755.

The last column of table 2 shows the effect of improvements in methanol's economic efficiency. A distinction must be made between technical and economic efficiency. As illustrated in the table, economic efficiency depends upon assumed technical efficiency measured in mileage per Btu for methanol and on the price of methanol. If technical efficiency improves--as is possible--and/or the price of methanol declines--which also is feasible--the economics of methanol vis-a-vis gasoline improves.

Table 2

Theoretical Comparison of Fuel Costs and Use for Methanol and Gasoline Vehicles

	Gasoline vehicle	Methanol vehicle (w/25% technical efficiency improvement)[a]	Methanol vehicle (w/85% technical efficiency improvement)[e]
Tank size (gal.)	22	22	22
Fuel cost (incl. tax[b]) ($/gal.)	1.38	1.05	0.85
Miles per gallon of fuel	25.0	13.9	20.8
Miles per million Btu [c][d]	216.6	245.7	367.8
Average annual mileage driven	10,000	10,000	10,000
Miles per tank of fuel	550.0	305.8	457.6
Cost per tank of fuel ($)	30.36	23.10	18.70
Tanks of fuel per year	18.2	32.7	21.9
Total annual fuel cost ($)	552.00	755.40	408.65

[a]Assume 1.8 gallons of methanol provides service equivalent to 1 gallon of gasoline (based on generally accepted estimates of potential efficiency improvements).

[b]Assume $0.20 gal. in State and Federal tax on both gasoline and methanol (based on average tax on gasoline, 1983). Volumetric taxes could discriminate against methanol due to lower energy content per gallon compared to gasoline.

[c]Gasoline contains 115400 btu/gal.

[d]Methanol contains 56540 btu/gal.

[e]Assume 1.2 gallons of methanol provides service equivalent to 1 gallon of gasoline (based on Bank of America's reported efficiency improvements).

This hypothetical methanol vehicle achieves 20.8 miles per gallon and averages 457.6 miles per tank. It would have to refuel 22 times per year for a total cost of $409.53--$143.00 a year less than for the gasoline vehicle shown in table 2. Experts, however, are skeptical that improvements in efficiency of this magnitude can be achieved.

Table 2 illustrates one of the problems associated with the use of neat methanol. A gallon of methanol contains about half the energy in a gallon of gasoline. Therefore, more methanol must be used to supply the same amount of energy presently supplied with gasoline. Methanol fuel may also require substantial modifications to vehicle engines and fuel systems. Differences in combustion characteristics between neat methanol and gasoline presently prevent fuel interchangability in vehicles. A vehicle calibrated to run on gasoline cannot operate satisfactorily on neat methanol unless it is modified. Likewise, a vehicle calibrated for methanol will not operate satisfactorily on gasoline. This situation is similar to that of gasoline and diesel fuel in vehicles. In addition, methanol presents engine wear and materials compatibility problems in engines, fuel storage, and distribution systems. These problems have not been completely resolved, although most analysts concede that they are not insurmountable. Aldehyde[4] emissions, (primarily formaldehyde) increase with neat methanol fuel use relative to gasoline, but test data indicate that these levels of currently unregulated emissions are low compared to the composite of unburned fuel (hydrocarbons) and can be reduced effectively with catalytic after treatment.

Methanol blended in small amounts (under 5 percent) with gasoline seems to have no noticeable negative technical or environmental effects. In such small percentages, methanol acts as an octane enhancer in gasoline, and tests to date indicate that it may improve engine performance. Methanol added to gasoline in larger percentages, but still under 10 to 12 percent, reduces or at least maintains similar levels of regulated emissions while extending gasoline supplies. However, these larger percentages of methanol increase aldehyde emissions. Methanol also seems to aggrevate evaporative emissions when blended with gasoline.

Additional possible negative effects associated with larger percentages of methanol in blends are still being debated. Methanol has potentially corrosive effects on certain automobile parts. This problem may require the use of engine and fuel system

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[4]Aldehydes are suspected carcinogens not regulated under present legislation.

materials which are compatible with methanol/gasoline blends. These blends may present similar materials compatibility problems throughout the entire gasoline storage and distribution system. These problems are not insurmountable but they may require, in some cases, replacement of certain types of hoses, tanks, and pumps. Burning blends containing more than 10 to 12 percent methanol exacerbate both regulated and currently unregulated emissions. Beyond a certain volume, methanol in gasoline increases carbon monoxide, nitrogen oxides, aldehyde, and unburned methanol emissions. High percentage methanol blends may also negatively affect engine performance.

In the future the potential for alcohol fuels and blends raises a number of problems. These extend to the entire fuel distribution system as well as to its use in vehicles. A great deal of work and attention has been devoted to identifying these problems, but solutions are not typically universally applicable. Problems in existing vehicles are, in general, exacerbated by larger concentrations of new fuel components, particularly methanol.

THE "CHICKEN AND THE EGG" PROBLEM

The problem of simultaneously introducing both methanol fuel and vehicles into the transportation sector on a significant scale has been characterized as the "chicken and the egg" problem. Production or conversion of methanol vehicles on a wide scale to take full advantage of the fuel requires a commitment of large amounts of financial resources. Before committing these resources, vehicle convertors and manufacturers require sufficient demand for vehicles. This, in turn, requires an adequate supply of the fuel itself. However, before fuel producers are willing to produce and market the fuel, they too must be assured of an adequate level of demand. On a dedicated, nationwide basis, the production and distribution of neat methanol, or even of a blend consisting of high percentages of methanol, will likely require some new infrastructure elements parallel to that of gasoline. These developments all require long lead times and entail high risks and costs for investors.

OBJECTIVE, SCOPE, AND METHODOLOGY

Our objective is to examine institutional and infrastructural impediments which may inhibit the establishment of methanol and/or methanol blends as commercially viable transportation fuels and to suggest policy options available to the United States Government which may help to remove, or at least diminish, some of these impediments.

We undertook this study at the request of the Chairman of the Subcommittee on Fossil and Synthetic Fuels, House Committee on Energy and Commerce. (See app. I.) This report builds on our previous work in the area of alcohol fuels. (See app. II.)

An important reason for considering options for eliminating impediments to the emergence of a methanol fuel market is the national security implications of developing a domestically produced alternative transportation fuel. Both the health of the U.S. economy and the security of the country continue to depend on assured supplies of fuel to the transportation sector. Approximately 58 percent of the oil consumed in the United States is devoted to this sector--roughly 9 million barrels per day. The Nation depends on imported supplies for about 34 percent of its oil needs, and therefore, remains vulnerable to supply disruptions. Using domestically produced methanol as either a substitute for, or as a means of extending petroleum based fuel supplies, could help enhance national energy security.

The introduction of methanol as a major transportation fuel faces many difficult hurdles. These include economic factors such as large capital requirements for a production and marketing infrastructure for both fuel and vehicles, high interest rates, and relatively stable oil prices. In addition, methanol will have to compete directly with gasoline and diesel fuel, the dominant fuels in the U.S. transportation system. Because of their dominant position, these fuels enjoy the advantage of established infrastructure and marketing systems. Furthermore, gasoline and diesel fuel are covered by an established regulatory framework governing their production, transportation, storage, handling, and use. In contrast, since no such framework exists for methanol fuel, a number of uncertainties surround methanol fuel production and marketing and the manufacture and sale of methanol-powered vehicles.

This study addresses primarily the non-economic, institutional and infrastructural inhibitions to the commercialization of methanol as either a "neat" fuel or as a blend with gasoline or diesel. It does not attempt to determine either the economic or technical viability of methanol fuel or methanol-powered vehicles. Other analysts--most recently the Office of Technology Assessment[5]--have looked extensively at these issues. Although

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[5]Office of Technology Assessment. Increased Automobile Fuel Efficiency and Synthetic Fuel: Alternatives for Reducing Oil Imports, Sept. 1982.

it is generally acknowledged that the economics of establishing a methanol fuel market pose a substantial barrier to methanol's commercialization, there is little the Federal Government can do to influence these factors, short of providing financial incentives. Beyond these economic factors, however, are certain Federal regulations which may present additional, though perhaps less substantial, impediments to a methanol fuel market. Unlike the economic barriers, these regulatory factors are within the control of, and thus could be altered by, the Federal Government.

We obtained information and data for this study through discussions with analysts in the fields of energy, marketing, and finance, and with experts in alcohol fuels. We interviewed private sector analysts who have done work related to methanol fuel such as representatives of the Renewable Fuels Association and private consultants currently or previously involved in work in this area. In addition, we contacted Government officials and analysts with the Departments of Energy, Transportation, Justice, and the Army; the General Services Administration (GSA); and the Environmental Protection Agency (EPA) that have either performed analysis in the area of methanol fuels, or whose agencies have issue area interest or regulations which may bear on methanol fuel.

We also interviewed current and potential producers, distributors, and marketers of methanol, including: DuPont, CONOCO, Sun Tech., Celanese, Future Fuels of America, Atlantic Richfield Company, and Energy Transition Corporation for their views on the problems involved in developing a market for methanol fuels. We contacted officials in the automobile industry whose companies have experience and/or interest in methanol vehicles, including: Ford Motor Company, General Motors, and Volkswagon of America. Likewise, representatives of companies involved in retrofitting gasoline vehicles to burn methanol such as Future Fuels of America, Bank of America, and others were interviewed to obtain their views and perspectives on the problems involved in methanol fuels' and vehicles' commercialization. We obtained information and views from officials of the California Energy Commission and Bank of America, which have had experience using neat and blended methanol in their vehicle fleets. In addition, we reviewed available literature relevant to our study.

As a preliminary step in preparation for this study, we reviewed the analysis, findings, and recommendations of the U.S.

National Alcohol Fuels Commission[6] included in their final report entitled, "Fuel Alcohol: An Energy Alternative for the 1980's."

Except as noted, this review was performed in accordance with generally accepted government auditing standards.

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[6]The National Alcohol Fuels Commission was established in 1979 by Public Law 95-599 to study the potential contribution of fuel alcohol and to recommend steps to realize this potential.

CHAPTER 2

FEDERAL REGULATIONS WHICH MAY POSE MARKET DISINCENTIVES FOR METHANOL FUELS

We identified several regulations or laws which certain analysts, fuel producers, and vehicle manufacturers believe may impede the development of a methanol fuel market, or, at least, contribute to establishing an atmosphere of uncertainty, making producers and manufacturers reluctant to make the required investment decisions. These regulations include those now in effect which either directly or indirectly bear on the use of methanol as a fuel and potential regulations that may ultimately affect methanol fuel. The absence of regulations in some areas raises uncertainty as to the nature and effects of probable future regulations.

The existing regulations specifically identified as potentially having inhibitory effects on the development of a methanol fuel market include: EPA emission standards and certification requirements, Corporate Average Fuel Economy (CAFE) Standards, vehicle labeling requirements, and EPA restrictions on "tampering" with vehicle engines. In addition, some maintain that specifications and standards comparable to those for gasoline and diesel fuel and vehicles are needed for methanol before a widespread market can develop. Finally, U.S. antitrust laws are alleged to inhibit cooperation between fuel producers and vehicle manufacturers which they believe is necessary to create a fuel and vehicle market.

We reviewed these regulations and laws to assess the validity of these assertions. We sought to determine whether these factors are significant barriers to the emergence of a methanol fuel market, or if there is merely a need to develop a greater degree of cooperation between the industries involved--or a trade association--and the Federal Government to reduce investor uncertainty. Our analysis indicates that, while some of these regulations may contribute to an atmosphere of uncertainty, they generally do not constitute barriers to development of a market for methanol in the transportation sector.

RESTRICTIONS UNDER THE CLEAN AIR ACT

Motor vehicle emission standards and requirements

Current motor vehicle emission standards and regulations raise two main issues regarding a methanol fuel market: (1) what effects these standards may have on the introduction of methanol/gasoline blends and neat methanol fuel into the marketplace and (2) whether or not the procedures required to verify a fuel's compliance with these standards impede the emergence of a methanol market.

Emission standards applying to blends

The first issue arises from the uncertainties surrounding the potential pollutant effects of both methanol blends and neat fuels. Blends of methanol with unleaded gasoline fall under the jurisdiction of Section 211(f) of the Clean Air Act which bans commercial use or marketing of new fuels or additives that are not "substantially similar" to gasoline, without EPA approval. A fuel manufacturer proposing to market any fuel or additive substantially different from that in use in 1975 can apply to EPA for a waiver of this prohibition, but it must supply EPA with evidence that the fuel or additive will not cause violations of emission standards or failure of vehicle emission control devices.

Before the EPA grants a waiver, individual fuel manufacturers must establish to the Agency's satisfaction that the fuel or additive will not cause a 1975 or later model year vehicle to fail to comply with the established emission standards. Applications for waivers must be granted or denied within 180 days, or they are automatically granted by law.

This statutory requirement is not a major impediment to the introduction of methanol/gasoline blends into the marketplace. It applies only to blends of methanol and unleaded gasoline--not leaded fuel--and permits production and sale of these blends as long as they do not violate motor vehicle emission standards. The regulation provides ample opportunity to obtain approval for blends which will not violate current standards. It limits the percentage of methanol that can be included in blends with unleaded gasoline to an amount which will not cause vehicle emissions to violate established standards.

Because of chemical differences between methanol and gasoline, the vapor pressure of gasoline is increased disproportionately when a small to moderate amount of methanol (1 to 10 percent) is added. EPA vehicle certification requirements reflect existing practices for gasoline fuel and associated vehicles. DOE reports that the disparity between EPA requirements and methanol/gasoline fuel characteristics causes confusion with State enforcement agencies. DOE suggests that EPA establish reasonable evaporative emission requirements based on both the Clean Air Act and the factors pertinent to methanol blends.

As of March 1983, six companies had applied for waivers to sell blends of unleaded gasoline with methanol, most including unnamed cosolvents[1] as additives in varying percentages. Two of these waiver requests were denied because EPA found that insufficient data was supplied by the manufacturers to prove that these blends did not significantly impact on air quality or emission control devices. In these two cases, the lack of data prevented EPA from fully reviewing the appropriateness of the blends,

[1]Cosolvents are additional chemicals added to the mixture to improve lubrication, inhibit corrosion, and improve water tolerance.

according to agency officials. Three other waivers were granted since the data provided gave EPA a basis for determining that these particular blends complied with the standards. EPA recently reviewed and rejected another application for a methanol/unleaded gasoline blend with 3 percent methanol and no cosolvents. This rejection was also due to insufficient data. To date, all waivers granted by EPA have been for methanol/gasoline blends with added cosolvents.

The EPA waiver, once granted, applies only to that specific fuel for which it was approved or for fuels with the same chemical components. Since the waivers that have been granted to date are for blends of methanol, unleaded gasoline, and unspecified chemical cosolvents, the waivers apply only to each specific blend and its components. The components of the unidentified cosolvents are proprietary, known only to the fuel producer seeking the waiver; as a result, the fuel for which the waiver was granted cannot be duplicated by others. In effect, under these circumstances, each producer that wants to market a methanol blend must go through the testing process to obtain its own waiver. Approval of a blend with all known components would facilitate the marketing of comparable blends by other producers and eliminate the costs of compliance verification for other than the initial waiver applicant. In submitting such a blend for approval, producers might be required to reveal more information about the product than in the past.

In one case, that of American Methyl Corporation (formerly Anafuel Unlimited), a waiver was granted for a blend of unleaded gasoline and a maximum of 12 percent methanol by volume, plus cosolvents, with the total alcohol content (methanol plus higher alcohols) not to exceed 15 percent of the blend. According to EPA officials, automakers have appealed to EPA to revoke this waiver and have taken the EPA to the U.S. Court of Appeals to try to force a revocation. The automakers are concerned that the blend with such high concentrations of methanol may have damaging long-term effects on engine and fuel system parts for which the automakers will be held responsible. At the same time, automakers fear that this fuel additive will cause their vehicles to violate the emission standards set for them, thus causing them to violate the law. EPA has recently initiated proceedings to reconsider this waiver. The actual level of methanol content in blends that will ultimately be found to begin causing emission problems is uncertain. There is a general consensus at this time that methanol blends of up to 5 percent with cosolvents are acceptable and that blends with methanol levels greater than 12 percent are not. There is disagreement over the desirability of blends between 5 and 12 percent methanol.

Compliance procedures

The motor vehicle emission standards set limits to the levels of particular pollutants that can legally be emitted from the burning of methanol blends. In order to verify that specific blends do not violate emission standards, these blends must be tested to determine the levels of regulated pollutants emitted.

This requirement, that a blend's compliance with the standards be verified before a waiver is granted by EPA, raises a second issue related to the first just discussed: Do the procedures for complying with emission standards and regulations impede methanol's market penetration.

Some fuel manufacturers and analysts characterize these EPA regulations and the compliance requirements as costly, time-consuming, and burdensome. A representative of one fuel company, which successfully obtained a waiver to blend methanol with unleaded gasoline, stated that his company had spent around $1 million to provide the test information required by EPA. While this official conceded that much of this required testing would have been performed by the company anyway as a normal procedure to ensure fuel quality prior to marketing, he considered the extent of the data required by EPA unnecessary and burdensome.

Officials of EPA, on the other hand, do not believe that either the regulations or the compliance procedures are unnecessary or burdensome, or that they are a significant barrier to the introduction of methanol blends. EPA officials note that these restrictions are in place to maintain environmental quality. Tests are used to indicate whether certain methanol/gasoline blends may cause increased levels of regulated emissions. Blends which are chosen through the testing process can be marketed without environmental problems. EPA officials maintain that, to date, environmental concerns have not impeded the introduction of methanol blends, in the sense that no waiver requests have yet been denied because test data showed the blends to be environmentally harmful.

EPA officials concede that the testing procedures may add to fuel manufacturer's costs beyond those incurred if the regulations were not in effect, but they do not consider these additional costs to be excessive. They maintain that many of the factors tested would be considered by manufacturers themselves before marketing the fuel, regardless of EPA requirements. These include emission characteristics, vehicle parts compatibility with methanol use (equipment deterioration), and driveability. These are all areas that manufacturers must also consider before marketing, since problems in any of these will affect the marketability of the fuel and may open manufacturers to damage suits.

Standards for aldehyde emissions not yet established

Uncertainties also surround the potential pollutant effects of neat methanol fuel. Tests conducted by various Government and private researchers and the State of California indicate that emissions from the burning of neat methanol fuels can fall below levels allowed under current regulated standards. However, there is some concern whether aldehyde and unburned methanol emissions associated with neat fuel use may become a future problem.

Emission standards and regulations that pertain to the aldehyde emissions associated with methanol fuels have yet to be

established. Since the current EPA standards are written in terms of gasoline and diesel fuels which emit little aldehydes, it has not yet been necessary to regulate these emissions. According to the Director of EPA's Office of Mobile Sources in testimony before the House Subcommittee on Fossil and Synthetic Fuels on August 13, 1982, regulations governing alternative fuels such as methanol have not been established because relatively few alternatively fueled vehicles have been sold and because unique test procedures would probably be associated with each fuel. He stated that "appropriate regulations would be established when a vehicle manufacturer indicates plans for the production and sale of a significant number of alternatively fueled vehicles." He testified that EPA does not believe that the lack of emission regulations or official test procedures will inhibit methanol vehicle development.

An EPA official stated that although there are currently no officially approved test procedures, those for gasoline-fueled vehicles are generally applicable for regulated pollutants, and also researchers are using well-known methods to measure unburned methanol and aldehyde emissions. Although such procedures would need to be standardized and formally adopted by regulation, EPA anticipates that these procedures would be completed long before manufacturers certify a significant number of pure methanol vehicles.

EPA's viewpoint regarding establishment of regulations for alternative fuels and methanol, in particular, is evident from this official's testimony and subsequent interviews: It is premature to develop standards and regulations for problems that do not yet exist. The logic behind this position is that EPA is charged with the responsibility of protecting the environment, and since relatively few alternatively fueled vehicles are operating--too few to cause widespread environmental concerns--no problems requiring EPA action have developed or seem likely to arise in the near future. In addition, the large number of potential alternative fuels which have not yet--and may not--become commercialized precludes EPA's anticipating and developing standards to deal with potential environmental problems that may be associated with <u>all</u> prospective fuels before they are used on a wide scale. Methanol fuel is just one of many prospective alternative fuels and should warrant no special attention relative to other options at similar stages of market development.

Therefore, EPA officials do not dispute the fact that there may be a need for regulations and standards governing methanol and other alternative fuels. Officials question, however, the immediate need for such regulations. They maintain that, once there is some clear indication that there will be sufficient numbers of alternatively fueled vehicles in operation to warrant environmental concern, <u>then</u> EPA will act to establish necessary standards and regulations.

Another factor constraining EPA action regarding aldehyde standards is that the need for EPA action on aldehyde emissions,

particularly formaldehyde--even if a widespread market for methanol fuel arises--has not yet been established. There is still debate among both private and public scientists as to the severity of the threat of cancer in humans from aldehydes. Although aldehydes have been shown to produce cancer in laboratory animals and are thus suspected carcinogens, there is insufficient evidence to judge the potential long-term effects of aldehydes on humans.

The likelihood that regulations and standards governing aldehyde emissions will eventually be established when a widespread methanol market develops, in conjunction with the uncertainty as to what these standards and regulations will entail, may impede market development. Potential methanol producers and vehicle manufacturers indicated that they are reluctant to undertake the investments necessary to create a methanol fuel market because of the uncertainty as to whether methanol will ultimately be designated an environmentally safe fuel or what means will be required to make it so. Many experts believe the emissions peculiar to methanol can be reduced with available emission control systems, but the absence of standards and regulations adds to investment risks. Therefore, standards and regulations designed specifically for the emissions from methanol fuel may be required before a methanol market can emerge.

Antitampering restrictions

Sections 203(a)(3)A and B of the Clean Air Act prevent vehicle manufacturers, dealers, operators of fleets, or others from knowingly removing or rendering inoperative any device or element of design in a vehicle or engine that comply with certification-approved manufacturer specifications relative to emissions. (The provisions do not apply specifically to individual vehicle owners although their vehicles must comply with established emission standards.) EPA interprets these provisions as prohibiting alterations to "emission critical components" in such a way that the vehicle violates regulated emission standards. The Administrator may provide exemptions in order to permit vehicles to use fuels other than those specified in certification testing. Presently, an existing vehicle cannot legally be modified by commercial entities to operate on neat or high percentages of alcohol without first obtaining an exemption from EPA to demonstrate that this vehicle complies with motor vehicle emission standards. Since experience demonstrates that little or no modification is required for vehicles to burn low percentages of methanol in blends, tampering restrictions would not apply to vehicles using small volumes of methanol. Only when vehicle modifications are needed for neat methanol will tampering restrictions come into play.

The U.S. National Alcohol Fuels Commission suggested that antitampering restrictions pose an impediment to the conversion of methanol vehicles. In its 1981 report, the Commission cited the relevant section of the Clean Air Act as preventing the alteration of vehicles and stated that "at present, therefore, an existing vehicle cannot be legally modified" by the groups noted in the legislation "to operate on pure alcohol or any other synthetic

fuels."[2] The Commission recommended that the Clean Air Act be amended to allow such alterations, providing the regulated emissions of the vehicle are not substantially different from those of unmodified vehicles. However, the proposed amendment is unnecessary since, as discussed below, EPA's current administration of the tampering provision effectively achieves the same result.

The Chief of the Tampering Section of EPA's Field Operation and Support Division told us that the antitampering provision as it stands should not impede conversions to methanol use provided these vehicles do not violate emission standards. (Test data and actual experience by fleet owners demonstrates that vehicles can be retrofitted to burn methanol and operate within established emission standards.) According to this official, the legislation clearly allows exemptions to the provisions, and as a matter of policy, the EPA has recently been willing to grant such exemptions when deemed reasonable. EPA believes that formalization of this process by amending the legislation is unnecessary. The agency is in the process of developing regulations governing the antitampering provisions which are designed to achieve the same end without formal amendment. EPA has published an advanced notice of proposed rulemaking, addressing among other matters, whether regulations are necessary or appropriate. This official stated that any regulations or policy revisions would not be more restrictive than current policies. EPA's intent is to make compliance with the law as easy as possible for those wishing to convert vehicles but at the same time maintain environmental quality. However, formalization of the regulations in a legislative amendment might provide greater continuity over time in administration of the antitampering provisions, and thereby, remove some degree of uncertainty.

EPA will grant exemptions for three reasons: for testing purposes, for research purposes, and for reasons of national security. Any persons or organizations wishing to convert a vehicle for commercial purposes must first apply to the EPA and supply basic information such as a description of the nature of the test being conducted and how many vehicles are involved. The EPA official we spoke with stated that this process is neither lengthy nor difficult; it can be conducted by mail and EPA can grant an exemption within 1 to 2 weeks. The applicant may then proceed to convert the vehicles and undertake the testing procedure. This official explained that EPA normally does not attempt to follow-up on the testing procedures or verify the results. The agency does little in the way of oversight or enforcement activities in this regard. EPA stipulates that the applicant must maintain a few simple records which would normally be kept in the course of testing. The agency has the authority to examine these records but, according to this official, has not done so to date. Assuming that the vehicle converted does not violate regulated emission standards, current procedures and practices allow the applicant to

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[2]U.S. National Alcohol Fuels Commission, "Fuel Alcohol: An Energy Alternative for the 1980s," Final Report, 1981, p. 22.

perform similar conversions--even on a commercial basis--under the "reasonable belief" that these conversions will not violate emission standards.

The cost of the federally approved testing procedure to verify a converted vehicle's compliance with motor vehicle emission standards is from about $500 to $1,000. This is a one-time expense to demonstrate that the conversion process used is acceptable. This expense should not prove an impediment to such conversions on a commercial-scale since it can be amortized over many vehicles.

Persons we interviewed who are currently involved in the conversion of vehicles to run on methanol fuel generally do not consider tampering restrictions as currently applied by EPA to be a significant barrier to their ability to convert vehicles.

Most commercial activity converting vehicles to use methanol is centered in California. California requires confirmation that converted vehicles meet State emission standards--which are more restrictive than Federal standards--but it is not necessary to request a waiver from the State or to undergo EPA Federal testing procedures. For this reason, and because of additional financial and other incentives provided by the State, it is easier and less costly to convert vehicles under California law. However, EPA accepts either evidence from Federal testing procedures or the approval of a State authority as proof that a converted vehicle complies with Federal emission standards. EPA's acceptance of California's determination that methanol vehicles meet the State's vehicle emission standards, therefore, facilitates commercial-scale conversions by allowing converters an opportunity to avoid the additional costs of Federal testing.

We believe that EPA's current application of the law allows ample opportunity for converting vehicles to burn methanol provided they do not violate emission standards. Since tests to date indicate that emissions from vehicles converted to burn methanol can meet or fall below regulated emission standards, restrictions on tampering should not constitute a serious barrier to wide-scale conversions.

FUEL ECONOMY MEASUREMENT

The Energy Policy and Conservation Act of 1975 (EPCA) established two major energy efficiency requirements for automobiles. First, the fuel economy of individual car models is to be estimated and displayed on the vehicle in order to provide consumers with a means of comparing the fuel economy of various models. In addition, these estimates are compiled according to a specified procedure in order to estimate the Corporate Average Fuel Economy (CAFE) of the total cars expected to be sold by a manufacturer during a model year. The CAFE is used to determine manufacturers compliance with mandated fuel economy improvements specified in EPCA. Both the individual and corporate average fuel economy measurements are stated in terms of miles per gallon of gasoline or diesel fuel.

Methanol by volume has only about half the energy or Btu content of gasoline; therefore, about two gallons of methanol equal the energy content of one gallon of gasoline. As a result, despite potentially significant improvements in the energy efficiency of automobiles running on methanol (in terms of miles/Btu), if fuel economy is considered strictly on a volume basis (i.e., miles/gallon), methanol vehicles could appear inferior to gasoline vehicles.

This perceived inferior status of methanol vehicles with regard to fuel economy could have negative impacts on both the production and sale of these vehicles. Although methanol vehicles are not presently covered by CAFE regulations, inclusion of methanol vehicles in the CAFE standards without development of a fuel equivalency factor could adversely affect manufacturers' overall economy rating and thereby discourage their production. Likewise, unless a fuel equivalency factor is established, labels for methanol vehicles displaying their fuel economy rating in miles per gallon could well discourage consumers from buying methanol vehicles, which appear less efficient.

An equivalency factor could easily be developed and adopted under current legislation. EPCA contains provisions for dealing with fuels with different energy contents. "Fuel" is defined in the existing legislation as "gasoline and diesel oil." However, the Secretary of Transportation may include any other liquid or gaseous fuel within the meaning of the term "fuel" if he determines that this action is consistent with the need of the Nation to conserve energy. Furthermore, the law states that "after the fuel has been included in this definition, the EPA Administrator shall determine the quantity of this fuel which is equivalent to one gallon of gasoline."

The most straightforward means of calculating a fuel equivalency factor would be to multiply the actual miles per gallon achieved by a methanol vehicle by a ratio of the Btu content of methanol to that of gasoline. This calculation would effectively rank vehicles on the basis of miles per Btu, yet maintain the more familiar terminology of miles per gallon. An example of such an adjustment is shown in table 3.

Table 3

An Example of Possible Equivalency Factor Adjustment of Vehicle Fuel Efficiency

	Neat methanol powered vehicle	Similar gasoline powered vehicle
Test results--measured in MPG of fuel	20	30
Btu/gallon of fuel[a]	56,560	115,400
Miles/100,000 Btu	35.36	26
Fuel equivalency factor	$\frac{115,400}{56,560} = 2.04$	
Miles per gallon of gasoline equivalent	40.8	30

[a]Estimates of fuel heating values vary considerably. We used the lower heating value estimates commonly accepted by DOE.

As shown above, even though the methanol vehicle derived about 33 percent fewer miles per gallon of fuel compared to the gasoline vehicle, when corrected for the energy content of the fuels, the methanol vehicle actually achieves 36 percent more mileage per Btu.

Methanol vehicles are not currently included under the CAFE standards or vehicle labeling program. Both DOE and EPA officials consider that not officially defining methanol as a fuel, and thereby leaving methanol vehicles outside of the jurisdiction of the CAFE requirements and vehicle labeling, relieves these vehicles of additional regulatory burdens. During the previous administration, DOT agreed upon request by a potential fuel producer to grant a rulemaking petition to include methanol in the definition of fuel for automotive fuel economy standards purposes, but this decision was later reversed under the current administration.

DOT officials state that subjecting methanol vehicles to CAFE regulations would only impose an additional regulatory burden on fuel and vehicle manufacturers. Further, they contend that the lack of fuel and demand for these vehicles constitute more tangible barriers to commerialization. EPA officials agree with this position.

This view acknowledges what is generally accepted--that there are more important, overriding factors than Federal regulations that are preventing a market for methanol fuel and vehicles from arising. DOT and EPA officials believe that developing a fuel economy equivalency factor for methanol vehicles would not overcome the more severe barriers preventing methanol's

commercialization. We agree with this view; however, we believe that removal of even small obstacles in the path of methanol fuel's market development would constitute a step in the right direction. Such actions will become increasingly significant if and when methanol use gains greater acceptance in the marketplace.

As noted, DOT and EPA officials believe that subjecting methanol vehicles to the regulatory burdens of CAFE requirements would not help market development and may hinder it. However, if--as some experience to date has indicated--an appropriate equivalency factor for methanol vehicles shows these vehicles to achieve higher fuel economy ratings than conventional gasoline vehicles, including methanol vehicles in CAFE standards could increase a manufacturers' overall corporate average, and thereby might act a production incentive. It may also be possible for EPA to develop an equivalency factor informally--outside of the CAFE standards--which could be used in vehicle labeling but would not subject methanol vehicles to the CAFE regulations.

One EPA official stated that, while he believes that establishment of an equivalency factor may be helpful to manufacturers, EPA has been reluctant to initiate the process of establishing one because they believe it is too early to take such a step until a more widespread market arises. Likewise, EPA officials agree that an equivalency factor for vehicle labeling purposes may aid consumer acceptance of these vehicles, but they maintain that it is premature to take such action. This is primarily an argument not against the need or desirability of an equivalency factor, but questioning the immediate need for establishing one. Although exclusion of methanol vehicles from the CAFE and labeling regulations may benefit these vehicles now, the likelihood that these vehicles will eventually be included in the regulations once a wider market arises creates uncertainties for producers and consumers. We believe that early establishment of a fuel equivalency factor for methanol vehicles, regardless of whether these vehicles are included in CAFE regulations and the vehicle labeling program, could help remove some of the manufacturers' investment uncertainties and improve methanol vehicle's attractiveness to consumers.

OTHER REGULATIONS AND STANDARDS FOR METHANOL FUELS

Methanol fuel specifications not yet established

Specifications and regulations pertaining specifically to the production, orderly commerce, and use of methanol as a vehicle fuel have not yet been officially adopted. Methanol, while in some ways less hazardous than gasoline, is toxic, volatile, and corrosive. Therefore, like other fuels or chemicals if not properly handled or used, it may damage personal health, the environment, and various equipment. Standards, specifications, and regulations governing all aspects of methanol's production and use may be necessary to facilitate development of an orderly market for the fuel. For example, analysts and industry representatives

state that on a very basic level, a technical and legal definition of neat methanol fuel (not actually 100 percent methanol, but rather a mixture of methanol and other chemicals) and methanol blends must be established so that performance expectations can be clearly established, engines properly designed, and automobile warranties appropriately written. Accepted standards would enable fuel supplies to be exchanged among producers and ensure basic compatibility of fuels so that adverse reactions will not occur if different brands are mixed in fuel tanks.

The establishment of fuel standards and specifications of the type that would facilitate the orderly commerce of methanol fuel has largely been left to private industry groups such as the American Society for Testing and Materials (ASTM), which has developed similar standards for other fuels. ASTM Committee D2 (its fuel specification committee) is presently considering establishing standards for methanol fuel and is conducting tests toward this end. However, according to ASTM representatives, the ASTM process for establishing specifications usually takes 5 to 10 years.

The Federal Government also plays a role in setting standards for transportation fuels. The General Services Administration (GSA) maintains standards on fuel procurement for Federal vehicles, and the military sets standards for military fuel uses. The military takes the lead in this regard (i.e., testing, describing, and specifying fuel characteristics), initially establishing military standards and then passing its work on to GSA. After these standards and specifications are adapted to civilian use by GSA, they become officially adopted Federal standards.

A spokesman for the Army Energy and Water Resources laboratory indicated that it anticipates beginning tests on methanol fuel in 1983 to determine the feasibility of methanol as a fuel or fuel extender in military ground systems. As part of this work, it expects to come up with descriptions and specifications for neat methanol and blends regarding quality, composition, and other pertinent basic factors. Unless the laboratory encounters problems, it expects to finish this work in about 1 year.

Efforts at cooperation between the Government and private industry in this regard may further the process of methanol fuel specification development. As a precedent, similar work done by the Army on gasohol (gasoline/ethanol blends) is now in the process of being adopted as the ASTM gasohol standard with little or no modification. It is possible that the military standards developed for methanol during the 1983 testing could be used as interim standards until the longer ASTM standard-setting process comes to fruition. As in the case of gasohol, there may be little difference between the military and ASTM specifications for methanol, thus reducing the risk of a major discontinuity resulting from a transition from such interim standards to those ultimately specified by ASTM.

Standards and specifications for distribution of methanol

As noted earlier, methanol has certain unique chemical properties that distinguish it from conventional fuels. These differences require that methanol be handled and shipped in ways that differ from other fuels. Although no specific standards or regulations for the handling of methanol fuel have yet been established or officially adopted, the Occupational Safety and Health Administration (OSHA) has developed standards specifying exposure limits for industrial methanol use, which it believes to be applicable for fuel use as well. Some private concerns such as the Bank of America have developed their own safety and handling procedures specific to methanol fuels. These procedures are intended to minimize worker exposure to undue hazard, provide ready counter-measures in case of accident, and maintain fuel quality.

Differences between the physical characteristics of neat methanol and gasoline bring about several safety related trade-offs. Unlike gasoline, methanol fires can be extinguished with water. While methanol in open air is considered to be less of a fire hazard than gasoline, fuel tanks containing methanol present a greater explosion hazard than gasoline. However, flame arresters in the gas tank filler seem to mitigate this risk. Low percentage blends of methanol in gasoline present essentially the same in-tank flammability hazard as pure unleaded gasoline.

Our review indicates that present regulations and standards for handling and shipping chemical methanol--where they exist--are generally compatible with methanol used as a fuel. None of the industry representatives we interviewed cited this as a particular hindrance to market development, and there is no evidence that an absence of specific standards and regulations for handling methanol fuel impedes the development of the market.

ANTITRUST CONCERNS SURROUNDING METHANOL MARKET DEVELOPMENT

Some Government and independent analysts, as well as officials of automobile manufacturing corporations and methanol producers, told us that U.S. antitrust laws may play some role in inhibiting the development of a methanol transportation fuel market. Some degree of cooperation and policy coordination is likely to be necessary between automobile manufacturers and fuel producers, especially during the initial phases of methanol fuel and vehicle marketing. Such coordination would have the aim of assuring that both methanol cars and fuel would be available in the same area of the country at the same time. Some industry officials have expressed concern regarding the possible antitrust violations involved in coordinating the two industries.

One official of a vehicle manufacturing firm stated that to establish a market for methanol, the methanol producers and automakers must coordinate their actions so that producers would supply continuing and growing volumes of methanol for a certain

stable price, within a specified time frame. At the same time, automakers would agree to produce a specific number of methanol cars by a mutually agreed upon date. By this means, both methanol producers and automobile manufacturers would be assurred that vehicles and fuel would be available concurrently. Such coordination reduces risks for both industries and makes investment more likely. However, U.S. antitrust laws may prohibit such activities, if they are considered to be collusion and price fixing. The fear that cooperation between methanol producers and vehicle manufacturers might subject one side or both to antitrust charges is a serious concern of both industries.

To date, the Antitrust Division of the Department of Justice has not commented on the development of any new transportation fuel or any potential antitrust concerns surrounding proposed linking of the fuel producing and consuming ends of the industry. Although the Department of Justice is not authorized to give advisory opinions to private parties, the Antitrust Division does in certain circumstances review proposed business conduct and make known the Department's intentions regarding enforcement of antitrust statutes. (See 28 C.F.R. §50.6.)

On the basis of our review some degree of cooperation between fuel producers and automobile manufacturers would be useful in the development of a fuel methanol market. The industries concerned should obtain the Justice Department's views on the nature of any antitrust problems which might interfere with this objective.

FINDINGS

Based on our review of statutes and regulations potentially bearing on methanol fuels, we found that, in general, these statutes and regulations do not constitute major barriers to the establishment of a market. However, some of these statutes and regulations may contribute to investors' uncertainty, making them reluctant to invest the money necessary to bring about a methanol fuel and vehicle infrastructure.

Motor vehicle emission standards in practice limit the amount of methanol that can be blended with unleaded gasoline to environmentally safe levels. Testing procedures used to demonstrate the blends' compliance with these standards do not appear to impose a serious impediment. The current absence of standards or regulations governing specific aldehyde and unburned methanol emissions creates uncertainty and may further add to investor reluctance. Likewise, the current absence of standards or regulations governing the orderly commerce--production, storage, handling, and use--of methanol fuel may have a similar impact.

Vehicle antitampering regulations, as currently administered by EPA, do not seriously restrict conversion of vehicles to burn methanol, provided these vehicles comply with emission standards. The absence of an equivalency factor for comparing methanol vehicles' fuel economy on an equal basis with vehicles using other fuels under the CAFE and vehicle labeling programs will likely have a negative effect on both the production and sale of methanol

vehicles. In addition, while antitrust restrictions may limit some specific cooperative activities of methanol fuel and vehicle producers, uncertainty in this regard can be reduced through consultation with the Justice Department. Industry/Government cooperation may alleviate much of the uncertainty surrounding the application of Federal statutes and regulations to methanol fuel.

CHAPTER 3

THE USE OF METHANOL-POWERED FLEETS AS A MARKET DEVELOPMENT CATALYST

Most fuel market analysts agree that establishing methanol as a viable transportation fuel will require the coordinated introduction of large amounts of methanol fuel and vehicles. However, they disagree over the effectiveness of fleet procurement as a means of initiating the process. Our analysis indicates that fleet procurement could, if conditions are favorable, help somewhat to stimulate the wider use of methanol fuel by the general public. However, the extent to which this would happen is uncertain. Widespread fleet use of methanol will require some incentive. If fleet use of methanol does become widespread, it is likely to provide only marginal impetus toward broad public commercialization.

Some analysts believe that initiating methanol vehicle and fuel marketing through fleets could serve several useful purposes. Fleets could be used to prove the economic feasibility of the fuel and vehicles. They could also provide a convenient means of identifying any potential technical, environmental, or other problems. Targeting fleets as the initial market for methanol offers several advantages in terms of scale and support systems. Recent data indicates that vehicles sold to fleets comprise approximately 13 percent of all new car sales in the United States. Fleet vehicles also account for 12 to 14 percent of all gasoline consumed. They often operate from a central location making initial fuel distribution and vehicle servicing requirements easier to accommodate. Finally, as methanol fleet conversion proceeds, some analysts argue that the combination of expanded methanol fuel production and the increasing number of methanol vehicles on the street can interact, expand, and lead to general commercialization.

Other analysts argue that captive fleets provide only an isolated market, with both fuel and vehicles restricted solely to the fleets themselves. Even if individual consumers want to use methanol vehicles, the fuel would not be generally available; rather it would be in the hands of fleet owners. According to this view, promotion of fleet use of methanol may be a "dead end" tactic representing an inadequate market for vehicle manufacturers and failing to establish the distribution infrastructure required for general availability of methanol.

The extent that fleet operations can provide a catalyst sufficient to establish a national methanol fuel and vehicle market depends on several factors: (1) the total number of fleet vehicles which could potentially use methanol, (2) the percentage of total potential fleets that actually switch to methanol, and (3) the subsequent steps taken to provide general public availability of both fuel and vehicles. For this reason our analysis examines the size of current fleets in the United States. We then discuss factors which will limit the usefulness of methanol to some vehicle fleets, thereby decreasing the percentage of

total fleets likely to switch to methanol and the necessity of providing public availability of vehicles and fuel.

THE POTENTIAL FOR METHANOL FLEETS IN THE UNITED STATES

In terms of numbers, total fleet vehicles in the United States offer a substantial initial market for methanol vehicles and fuel. Fleet cars are replaced more quickly than individually owned automobiles. However, on closer examination not all fleet vehicles are good candidates for the initial phases of a transition to methanol fuel. In addition, it is not clear that there is sufficient motivation at present for most fleet owners to consider a transition to methanol fuel.

Automotive fleet size and types of use

Approximately 123 million automobiles are presently operating in the United States. Vehicle fleets of 10 or more account for approximately 6 to 7 percent of this total. If cars in fleets of from 4 to 9 vehicles are included, these fleets account for 10 to 11 percent of total vehicles.

As shown in table 4, business fleets account for more than 43 percent of the total of fleets of 10 or more and 33 percent of cars in fleets of 25 or more. However, about 30 percent of business fleets are composed of leased vehicles. It is not clear what effect this fact would have on methanol conversion. Government vehicles account for about 12 percent of total cars in fleets of 10 or more, with the Federal Government's share at about 3 percent. Table 5 shows the projected stock of fleet automobiles to the year 2000.

Table 4

Automobiles by Type of Fleet of 10 or More -- 1979
(thousands of cars)

	Number	Percent
Business fleets	3174	43
Individual leased	1690	23
State and local government	645	9
Utility (gas and electric)	529	8
Daily rental	462	6
Police	291	4
Taxis	207	3
Federal Government (Civilian)*	169	2
U.S. Postal Service	106	1
Federal Government (Military)*	79	1
Driver school	21	-
Total	7,373	100

*Domestic only.

[a]ICF developed these estimates at the request of the U.S. National Alcohol Fuels Commission.

Source: ICF Incorporated,[a] Washington, D.C.

Table 5

Projected Stock of Fleet Automobiles
(millions of cars)

Year	Fleets 4 to 9	Fleets of 10 or more	Total
1975 (actual)	4.4	6.0	10.4
1985	4.1	9.3	13.4
1990	3.8	10.3	14.1
2000	3.8	12.8	16.6

Source: Argonne National Laboratory.

This data indicates that total fleet size will continue to increase over the next two decades. Cars in larger fleets are projected to more than double between 1975 and 2000, while smaller fleets will decline.

The percentage of these total fleets which could become methanol fueled vehicles is difficult to determine. This forecast depends on the attrition rate of present vehicles and the rate of purchase of new vehicles. Table 6 shows an estimate of projected new automobile sales to fleets of 10 or more vehicles.

A comparison of tables 5 and 6 shows that about 25 percent of cars in fleets of 10 or more are expected to be replaced and/or added each year. Thus, if all new car sales to these fleets were methanol vehicles, it would provide a significant market for methanol vehicles, and after about 4 years, all vehicles in fleets of 10 or more would be burning methanol. This projection, however, is unrealistic, since it is unlikely that all new car purchases will in fact be methanol-powered, even under the most favorable circumstances.

Table 6

New Automobile Sales to Fleets of 10 or More
(millions of cars)

Year	Fleet size	Annual sales	Percent
1985	9.3	2.1	22.6
1990	10.3	2.6	25
2000	12.8	3.3	25.8

Source: ICF Incorporated.

Factors limiting the market penetration of methanol fleet vehicles

There are both technical and economic factors which will limit the rate of introduction of methanol vehicles into fleet use. Technically, in the early years, the potential for use of methanol in fleets is limited because the fuel achieves fewer miles per gallon than gasoline. Even taking into account improved fuel efficiency of methanol in specially designed vehicles, a larger volume of fuel is needed to go the same distance as a gasoline fueled car. As a result, unless methanol cars have substantially larger fuel tanks, or unless greater fuel efficiencies are achieved, these vehicles will have to refuel more frequently. However, as the size and weight of tanks increases, fuel economy would decrease. As long as methanol is not widely available, the driving radius of methanol vehicles from centralized fuel supply sources will limit the usefulness of these vehicles to some fleet owners. Until supply is more widely available, methanol can be used only in fleet cars operating within a narrow geographic range and able to return for fuel to a central site.

With a 22 gallon fuel tank, a methanol car would have a round trip driving range of about 300 miles; if it had to get fuel from a centralized source and return to that source to refuel, its

range would be only within a radius of 150 miles. Survey data[1] indicates that about 75 percent of total fleets may need vehicles having a driving range capability of more than 150 miles. Fleet operators were asked how far their vehicles must be able to travel on any given day. Table 7 illustrates the response. This data show that a relatively large portion of utility, rental, taxi, and Government fleets' required daily range of 150 miles or less. Based on this criterion, these fleets may be likely initial candidates for methanol use.

Table 7

Needed Daily Driving Range Capability
(in percent)

Fleet use	0 to 150 miles	Over 150 miles
Police	3	97
Government	32	68
Utility	57	43
Taxi	39	61
Rental	40	60
Business	18	82
Total	26	74

Source: Joseph Wagner, Fleet Operator Data Book, Sept. 1979.

Another factor to be considered is the feasibility of vehicles that do not require a range greater than 150 miles to return to a central refueling station on a regular basis. In this regard, fleet operators were asked in the survey what percentage of cars are idled for 8 hours a day at a central location. Their responses are contained in table 8.

[1]Survey of fleet operators by the Department of Energy and Automotive Fleet Magazine, reported in Fleet Operator Data Book, (September 1979).

Table 8

Garaging Information

Fleet use	Percent of all cars
Police	20
Government	49
Utility	51
Taxi	25
Rental	18
Business	20
Total	28

Source: Joseph Wagner, Fleet Operator Data Book, Sept. 1979.

This data indicates that a relatively large percentage of utility and Government vehicles are garaged at a central location for 8 hours. However, these figures are somewhat deceiving. Other fleet vehicles that may return to centralized fueling facilities for shorter periods of time are not included. This implies that a larger total percentage of fleet vehicles might be able to return to their base and refuel.

ICF Incorporated, which included these data in a report for the U.S. National Alcohol Fuels Commission, concluded that 26 percent of fleet cars need only a 150-mile driving range. Therefore, they are likely initial candidates for methanol use in early market stages, as are the 28 percent which return each day to a central garage for 8 hours or more.[2] ICF suggests that utility, Government, and taxi fleets may be the more likely users of methanol during the infancy of the methanol industry because these sectors of total fleets have the largest percentage of vehicles, which can both function under a 150-mile radius limitation and can return to a central refueling facility.

By applying the survey data to data on total fleet size, we can derive an indication of the potential initial fleet market for methanol. Comparing table 7, which illustrates the more severe and more definite limitation, to table 4 indicates the total number of utility, taxi, and Government fleet vehicles which might be eligible for use of methanol. This amounts to 286,000 Government vehicles, 301,500 utility vehicles, and 80,700 taxis, a total of 666,000. Assuming that most of these vehicles could return to a centralized fueling facility on a regular basis gives an unquestionably rough but not unreasonable estimate for the initial potential fleet market for methanol. If about one fourth of these fleets is replaced annually, our calculations indicate a maximum potential market for new methanol vehicles at roughly 160,000 vehicles per year.

[2]There is some, but not necessarily complete, overlap between the two categories.

Besides technical constraints, it must be emphasized that there is as yet no unequivocal proof of any capital, operating, or overall life-cycle cost advantages of methanol fuel and vehicles. As such it is unclear what incentive private fleet owners would have to switch to methanol. In addition, many fleet operators consider resale value of their vehicles to be a primary criterion for an automobile purchase. If methanol is not widely available, the general public will not be motivated to purchase used methanol vehicles, and resale value of methanol vehicles will probably be quite low.

Fleet test programs and cost experiences

Several organizations are currently testing the economic and technical viability of methanol and/or methanol-gasoline blends in their automotive fleets. They have produced a wide range of reported cost estimates of methanol vehicle fleets suggesting that the economic benefits of methanol use in fleets are by no means certain at this stage in the development of the market.

California Energy Commission

The State of California initiated a fleet program to test methanol fuel for two principal reasons. First, it wants to reduce dependence on imported sources of transportation fuel and associated vulnerability. Second, it wants to find a substitute fuel which would be more environmentally benign and energy efficient than petroleum-based fuels. California's fleet experience to date gives some indication of the costs and benefits involved.

In 1978, the California Energy Commission (CEC) tested four Honda Civics for a year on blends of alcohol and gasoline. These tests included use of blends of 5, 10, and 15 percent methanol in gasoline. The CEC concluded that blends up to 10 percent methanol did not adversely affect driveability, exhaust emissions, or cause phase separation (separation of methanol from gasoline). However, evaporative emissions increased 450 percent. Blends of 15 percent methanol required retuning and vehicle carburetor modifications.

In addition, to encourage neat alcohol fuels, the CEC began a $2-million Alcohol Fleet Test Program. The program began with an operating fleet of 112 light duty vehicles--62 of which run on neat methanol in regular-duty, high-mileage, typical fleet operation. Four of these vehicles are 1980 Ford Pintos which were purchased new as gasoline vehicles and then retrofitted. The purpose of running these vehicles was to evaluate the cost and practicality of converting in-service gasoline fleet vehicles to operate on neat methanol. Results to date indicate that a mass produced conversion kit would range between $1,000 and $3,000, depending on desired improvements in efficiency, driveability, performance, and the quantity of vehicles to be converted. The fleet test also includes 10 1981 VW Rabbits and 8 1981 VW pick-ups, which were the first neat alcohol vehicles produced on an assembly line in the United States. In addition, the Los Angeles County Government, under contract with the CEC, operates 40 1981 Ford Escorts, also designed specifically as neat methanol vehicles. These fleet

tests have the goal of achieving a mass-produced vehicle to avoid the high parts and labor cost experienced in converting existing gasoline vehicles to operate on neat alcohols. These fleets are designed as a first step in resolving the "chicken and egg" problem associated with the risk of providing either vehicles or fuel as a first step to widespread market development. Fuel for the fleet test vehicles is provided by Douglas Oil (a subsidiary of Conoco). Five service stations have been established with special pumps, tanks, and hoses to distribute the fuel.

In 1982, the California Energy Commission requested $5 million from the Energy and Resources Fund (established by the legislature in 1980) to purchase an additional 900 alcohol-fueled vehicles for use by State and local governments, establish 50 to 100 commercial alcohol refueling stations throughout California, and develop and test prototype high performance police vehicles and purchase 100 of these vehicles for the California Highway Patrol. The CEC also planned 20 additional refueling stations for these police vehicles. As of April 1983 contracts for the purchase of 504 methanol powered Escorts have been approved.

The Alcohol Test Program is continuing and data is still being collected. The data and conclusions generated from these fleets will provide the basis for CEC recommendations on the overall practicality and cost-effectiveness of methanol (and ethanol) for motor vehicles in California. CEC recommendations relative to retrofit vehicles and test results from the manufactured vehicles are expected in 1983.

Experience to date indicates certain positive results for the CEC fleet. The fleet of retrofit vehicles comply with 1980 California emission standards, demonstrate laboratory fuel economy results (determined by the amount of energy used) equal to or better than the gasoline control vehicles' results, and show minimal down time and expense for maintenance and repairs. The question of cost-effectiveness still remains to be answered, since operation and maintenance costs relative to the gasoline control vehicles have not been fully assessed. Conversion costs will also have to be determined. On a per vehicle basis, the conversion costs were about $2,100 for parts and $6,800 for labor, including testing. The CEC estimates that conversion costs could be about $1,000 for parts and from $500 to $1,000 for labor.

The results of the CEC's other two fleet programs involving prototype manufactured vehicles are somewhat more tentative. The methanol prototype Ford Escorts have to date also met all program goals for fuel economy, emissions, and performance. During the next several months, test vehicles will continue to be monitored for continued compliance with program goals in these areas and also for durability, operation, and maintenance costs.

In general, CEC representatives characterize the test results to date as very promising. Vehicles are living up to program expectation, and the CEC expects to expand California's use of neat methanol vehicles throughout the State.

Bank of America

A number of private corporations have also undertaken fleet test programs using both methanol-gasoline blends and neat methanol. The Bank of America (BOA) started the largest test program in 1979. The Bank is currently running 150 of its normal gasoline engine fleet vehicles on blends consisting of about 4 percent methanol. It initiated a test program to demonstrate the practicality of fleet use of methanol/gasoline blends. The BOA's fleet tested blends of 2, 4, 8, and 12 percent methanol in everyday operation to determine operational, environmental, logistic, and economic feasibility. Results showed that when used in 1975-79 model vehicles, a small increase (3 percent) in fuel economy resulted. In some 1980 cars, a 13-percent increase in fuel economy resulted. Analysts contend that the difference in these results is probably primarily due to more sophisticated technology in newer cars. Because the blends were less expensive per gallon than unleaded gasoline and no difference in maintenance costs was noted, a reduction in operating costs of about a cent (0.6 to 1.5 cents) per mile was realized. Bank officials consider this a significant saving to a fleet operator such as BOA whose fleet travels 40 million miles per year. The Bank of America estimated that blends use will provide a return on investment of over $4 million in 10 years.

After the completion of the test program, a 4-percent methanol blend with gasoline was chosen as the set mixture to be used in the 150 vehicles. It was determined that the 4-percent blend provides a 1.5-point increase in octane and, in some cases, has resulted in an increase in mileage over gasoline use.

In addition, the Bank now has 261 vehicles operating on neat methanol fuel. Future Fuels of America performed the initial vehicle conversions. Now the Bank converts its vehicles in its own facilities at a cost as low as $400 per vehicle, according to a BOA Vice President. By 1984, the Bank expects to have about 500 vehicles or approximately 20 percent of the Bank's 2,500 vehicle fleet converted to neat methanol. Officials at the Bank of America are, to date, greatly pleased with the results of the test program. They are planning ultimately to convert their entire fleet to methanol use. One bank official stated that there were no unresolved problems with the fleet: the vehicles meet all motor vehicle emission standards, they have solved all wear problems, there are no material compatibility problems, and the vehicles are experiencing superior performance at a lower cost.

Many transportation analysts contend that increased engine compression ratios are necessary to use methanol efficiently. However, BOA has found that the General Motors Citation V-6 engine works well with methanol without major engine modifications. The original conversions (248 vehicles performed by Future Fuels of America) included raising the compression ratio of the engine. BOA now has converted 13 of its own cars at a much lower cost (about $400 compared to up to $2,000 or more per vehicle) without changing compression ratios. BOA officials state that their experience to date demonstrates that high-compression cars are not

always necessary to take full advantage of methanol's properties. Furthermore, BOA's tests show that their methanol Citations have achieved better than 1.17 to 1 fuel conversion ratio with gasoline. That is, these Citations required 1.17 gallons of methanol to go the same distance as other Citations went on 1 gallon of gasoline. It should be noted, however, that, in spite of BOA's assertions, many analysts question these efficiency achievements. DOE, in particular, is skeptical about BOA's results.

BOA's Vice President has estimated that the combination of the two programs--use of neat methanol and methanol blends--will bring a return on an investment of from $2 to $8 million in 8 years on an original investment of $0.5 million. These, he insists, are conservative estimates.

To date, comparison of the CEC and BOA experience with fleet use of methanol indicates similar derived benefits. Both fleets experienced increased fuel economy, improved vehicle performance, and no evidence of any regulated emission problems. The only significant differences are the conversion costs and the extent of improvement in vehicle efficiency. While the CEC's costs of conversion were greater, their efficiency improvements were less than those of BOA. Both differences may be explained by the differences in vehicles used and the extent of the modifications. Generally, however, experience to date of both fleet programs with neat methanol fuel has been very positive.

IGT estimates

The Institute of Gas Technology (IGT) recently calculated life-cycle costs for the conversion of a specific 70 vehicle fleet[3] to use methanol fuel. While these calculations are both site- and fleet-specific, and therefore, cannot easily be projected to fleets in general, they give some indication of the potential life-cycle costs associated with conversion of a fleet to methanol.

Table 9 shows the life-cycle cost data used in the analysis, savings-to-investment ratio, and simple payback period for conversion of the 70-vehicle fleet to methanol using different assumed fuel costs. For this analysis, future expenses were adjusted to present values and a 7-percent discount rate was

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[3]IGT calculated the economic and technical feasibility of converting a commuter vehicle fleet to alternative fuel use, including methanol. This fleet normally travels between Goldstone Deep Space Communications Complex of the Jet Propulsion Laboratory, and Barstow, CA., a round trip of about 90 miles. The fleet consists of 47 vans, 22 sedans, and 1 pickup truck. As reported in: "The Effect of Price Uncertainties in the Fuel Selection Decision: The User's Dilemma," T. D. Donakowski, et. al., presented before the Nonpetroleum Vehicular Fuels III Symposium, October 12-14, 1982.

used. A 15 year expected life of the conversion (retrofit) was assumed. Increased maintenance costs for methanol fueling stations were assumed to be offset by reduced vehicle maintenance (fewer oil and spark plug changes).

The table indicates that life-cycle costs and therefore economic feasibility are quite sensitive to fuel price; they depend critically on assumed prices of methanol and gasoline. At certain fuel prices, methanol conversion has a negative savings to investment ratio (the costs of investment will not be recouped and there is no motivation for conversion). If methanol maintains lower fuel costs compared to gasoline, however, methanol conversion becomes economically feasible and investment costs can be recouped. The time involved varied with the price differential between gasoline and methanol. Therefore, the motivation to convert to methanol will depend on the perceived future price of methanol fuel compared to gasoline.

Table 9

Life-Cycle Cost Data, Savings-to-Investment (SIR) Ratio, and Simple Payback Period for Conversion of 70 Vehicle Fleet to Methanol

	$0.99/gal of methanol[a]	$0.79/gal of methanol[b]
Investment	$121,300	$121,300
Annual fuel cost	$219,000	$175,000
Savings-to-investment ratio	-2.28	+2.02
Payback (years)	NA	5.8

[a]$0.99/gal of methanol was the expected price of fuel in the Barstow area. This is consistent with recent prices paid by Bank of America in San Francisco. Prices have fluctuated; those used here are for illustration.

[b]IGT estimated that while recent prices for methanol in the Barstow area result in methanol conversion being not cost effective, if the price of methanol were reduced 20 percent its SIR would be positive. This lower price for methanol is consistent with some reported methanol prices resulting from the present supply surplus.

Source: "The Effect of Price Uncertainties on the Fuel Selection Decision: The User's Dilemma," T. D. Donakowski, et. al. paper presented before the Nonpetroleum Vehicular Fuels Symposium, October 12-14, 1982.

GAO estimates

Our recent GAO analysis[4] indicates that converting and operating a methanol-fueled vehicle could cost between $1,288 and $6,657 more than a conventional gasoline-fueled vehicle over a 5-year period. The difference depends on prices of gasoline and methanol, the discount rate applied to the life cycle cost estimate, and the assumed ratio of miles per gallon of gasoline to miles per gallon of methanol. These cost estimates assume a 5-year, 100,000-mile life to the automobile and a $1,500 conversion cost.

The potential for Federal fleet use of methanol

Some proponents of methanol fuel believe that the Federal Government could make a major contribution to overcoming methanol's infrastructural barriers by using methanol vehicles in its own fleet. Converting the Federal fleet to methanol fuel could potentially provide a significant market for methanol and methanol vehicles. It would also signal methanol producers, automakers, as well as potential private fleet owners, that the Government believes methanol is a viable fuel.

According to the Federal Motor Vehicle Fleet report for fiscal year 1981--the latest year for which detailed data is available--all Federal Government civilian and military agencies had a total of 436,000 motor vehicles in both domestic and foreign fleet operations that year. This number is somewhat more than the 1979 figure in table 4 which includes only domestic Government vehicles. It includes: sedans, station wagons, ambulances, buses, trucks, and special use vehicles. Based on recent turnover rates reported by GSA, the Federal fleet could provide annual demand for a maximum of 12,000-15,000 new automobiles. However, not all vehicles in the U.S. Government fleet are good candidates for conversion. Because of the more advanced state of technology for use of methanol in spark-ignited gasoline engines, the most likely candidates--at least in the near term--are those vehicles which currently run on gasoline: the sedans, station wagons, ambulances, and some trucks. The automobile/ambulance portion accounts for a total of 117,700 vehicles; trucks running on gasoline account for roughly 269,500 vehicles, for a total of about 387,000 vehicles. Not all these vehicles could operate within the range limitations mentioned earlier. Moreover, the Federal fleet is a collection of autonomous small fleets dispersed among agencies and parts of the country. Establishing central

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[4]U.S. General Accounting Office; "Assessing the Feasibility of Converting Commercial Vehicle Fleets to Use Methanol as an Offset in Urban Areas" (PAD-82-39), June 11, 1982.

fueling facilities to service a significant number of Federal vehicles would be difficult and costly.

Federal fleet conversion to methanol is unlikely to have a major direct impact on the development of a methanol fuel market in the sense of providing any significant level of demand for vehicles and fuel. DOE has suggested that a Federal methanol fleet could provide a continuing mechanism for further experience and development through vehicle purchases along the lines that have been provided by California for the past few years. This action could also overcome a limitation of the CEC sponsored work in that cold weather experience is essential to the automotive and fuels industry if they are to minimize the risks of commercialization. A Federal methanol fleet, moreover, might have a psychological impact on a methanol fuel market since it would literally constitute a Federal endorsement of the fuel, and thereby, remove some investor uncertainty.

Estimates of demand required to stimulate methanol vehicle production

In order to motivate fleet operators as well as the general public to convert to methanol-powered vehicles, the vehicles must sell at competitive prices. Vehicle manufacturers maintain that mass produced, assembly-line methanol vehicles could be marketed at comparable or only slightly higher initial cost than conventional vehicles. Assembly line production requires a certain minimum level of operation in order to capture the necessary economies of scale and to justify the cost of the required production line modifications. What that minimum production may be is debatable. The U.S. National Alcohol Fuels Commission report stated that initial annual demand of 50,000 vehicles would be sufficient to induce manufacturers to mass produce cars at only a 5-percent increase over the price of regular cars. One energy analyst stated that demand for 100,000 new methanol vehicles a year would be required. A representative of a major auto company which has developed prototype methanol vehicles on an assembly line, as well as other analysts, claim that demand for 150,000 cars a year would be needed.

Annual demand for 150,000 new cars--and in particular, for new methanol vehicles--is quite high. The best selling American car model, the Ford Escort, is projected to sell only slightly more than 150,000 units in 1982. It appears unlikely that a methanol car could attain initial annual sales comparable to the most popular U.S. models. A specially designed engine and fuel system are the important elements in a methanol vehicle. These could probably be used in various models, and thus could attain a wider market than a single vehicle model. One hundred fifty thousand vehicles equal approximately one quarter of the maximum potential initial fleet market discussed above (utility, taxi, and Government fleets) or the estimated maximum annual turnover rate for these fleets. It is conceivable, therefore, that fleet operators could provide a market for new methanol cars

sufficiently large to induce manufacturers to produce neat methanol vehicles.

Normal attrition and replacement of vehicles in the Federal fleet alone would not be sufficient to induce manufacturers to gear-up assembly line production of new methanol vehicles. As mentioned above, annual Federal fleet procurement in recent years has run about 12,000-15,000 cars, well below the lowest estimates for demand required to make assembly-line production of methanol vehicle cost-effective.

Vehicle conversion

Another option for making a transition to methanol is converting fleets from gasoline to methanol by modifying existing vehicles as BOA and others have done. Combining conversions of existing vehicles and replacement of old ones would accelerate the growth of a methanol fuel market.

Estimates of the costs involved in converting gasoline vehicles to methanol fuel vary considerably. In a recent report,[5] we enumerated a variety of conversion costs for different vehicle models reported by several sources. These estimates ranged from about $800 to $2,000 per vehicle depending on the type of vehicle involved and the extent of the modification performed. As noted, one BOA official reported that the Bank can convert GM-V-6 Citations to methanol at a considerably lower cost--about $400 per vehicle--primarily because the compression ratio in the engine is not changed.

The importance of vehicle conversion to the development of a methanol fuel market is likely to depend on its overall life cycle costs compared to those of new methanol vehicles. In the absence of experience and firm cost estimates with either option it is difficult to determine how large a relative role conversion may play.

Further actions necessary to make fleet procurements an effective methanol market catalyst

Fleet procurement can potentially be an effective means of inducing automobile manufacturers to produce methanol vehicles and getting fuel producers to provide fleets with sufficient fuel. However, fleets do little to provide the widespread fuel distribution infrastructure needed to make ownership of methanol vehicles practical for the general public.

One option for extending availability of fuel from fleets to the public might be for fleet operators to contract with local fuel distributors and retail service stations to act as the source

[5]"Assessing the Feasibility of Converting Commercial Vehicle Fleets to Use Methanol as an Offset in Urban Areas" (PAD-82-39, June 11, 1982).

of methanol fuel for their fleets rather than using their own private fuel facilities. These distributors could also open their methanol pumps to the public. Making fleet methanol pumps available to the public in this way could at least form the nucleus of a general distribution infrastructure. Service station owners would have to undertake the investments required for installing methanol pumps and new storage tanks at a cost of about $10,000. This cost would probably be no greater than the cost to a fleet owner of installing his own methanol facilities. Under these circumstances, it might be possible for fleet operators to defray at least some of the cost of installing the fueling facilities in retail stations. A methanol fuel market will take longer to develop if such measures are not taken.

Observations: Motivation for converting to methanol

Our work is based on the presumption that there must first be some motivation on the part of fleet operators and, ultimately, public consumers to switch to methanol fuel and vehicles before a widespread market will emerge. This motivation may take different forms for different parties: economic benefits through reduced operating costs, security of supply, or improved environmental conditions. Economic motivation appears to be highly sensitive to the relative costs of methanol and gasoline.

We see the potential contribution of fleets to be as follows: assuming that the motivation is present to induce fleet operators to purchase methanol vehicles, these vehicles must initially be fueled in a central location. However, the range limitations to the fuel will likely create a demand for dispersed fueling locations. Once the demand becomes sufficient, the market may respond and dispersed fueling stations built. These stations would also be available to the public, thereby providing the fuel availability required for individual consumer ownership of the vehicles. Assuming that individuals also have some motivation to purchase the vehicles, a widespread methanol transportation fuel market could then emerge.

This scenario is predicated on the assumption that fleets have some considerable motivation to switch to methanol. The fleets that have converted or are in the process of experimenting with methanol have done so for an array of different reasons: the California Energy Commission is primarily interested in an environmentally superior alternative to gasoline; BOA is interested in methanol for security of supply reasons. Another possible motivation might be the potential for reducing particulate and smoke emissions from diesel engines in urban buses provided that economic and technical problems can be overcome. Perhaps the most compelling motivation for fleet use of methanol--especially for private fleets--may be economic benefits. However, as discussed above, the economic benefits associated with methanol use in fleets are highly uncertain. Costs of conversion, ultimate costs of new methanol vehicles, overall life-cycle costs, future fuel costs all are highly uncertain at this stage and may, in

fact, be prohibitive for some fleets. Added to this are the concerns of resale value of methanol cars and technical uncertainties. These factors may overshadow any motivation that fleet operators may have to convert to methanol. Therefore, at least in the short term--in the initial phases of the market--fleets appear to have little motivation to switch to methanol fuel. Like concerns will also suppress any motivation that the general public may have to purchase methanol vehicles. The motivation for use of methanol fuel is by no means assured at this point.

CHAPTER 4

POTENTIAL FOR METHANOL FUEL IN DIESEL FUEL

MARKETS AND SOURCES OF METHANOL SUPPLY

We examined the potential for methanol use in current diesel markets as a possible mechanism to further the commercialization of methanol fuel. In addition, we looked at the likely future sources of methanol should demand for the fuel increase in the transportation sector. Our analysis indicates that use of methanol in diesel applications is technically possible, but apparently it is an inferior substitute in current engines. Although engines that could burn methanol efficiently and substitute for diesel engines in heavy-duty applications are varying in stages of development, to date no viable substitute engine has been thoroughly commercially proven.

Future methanol supply will come from domestic natural gas, domestic coal reserves, biomass, or imports. Neither coal- or biomass-based methanol fuel currently appears to be economically feasible in the foreseeable future. If additional domestic natural gas based methanol production facilities do not come on line--and many believe they will not--fuel use of methanol may lead to dependence on another imported source of energy for the transportation sector.

METHANOL FUEL AS A SUBSTITUTE FOR OR ADDITIVE TO DIESEL FUEL

Use of methanol in areas now dominated by diesel would substantially widen its market possibilities but, at the present time, the outlook for its use in these areas is uncertain. The principal limiting factors involved are current technical constraints and an absence of any proven performance or economic benefits for methanol over diesel fuel use. Unlike the gasoline/methanol situation, at the present time in the United States, there is no viable, thoroughly tested, and commercially proven neat methanol alternative to the diesel engine in heavy duty applications. However, new modified methanol burning engines for heavy transportation use are currently in varying states of testing and development, and may soon be demonstrated. Methanol can be blended with diesel fuel in small quantities and used in current diesel engines. Small quantities of methanol added to diesel fuel help reduce particulate emissions from conventional diesel engines. There is, however, some concern about the corrosive effects of methanol on portions of diesel fuel systems.

Because of basic differences in the fuels themselves, there are many areas in which methanol and diesel fuel are not as compatible, or do not relate as favorably, as methanol and gasoline.

Current high-speed diesel engines used in the transportation sector require fuels with a cetane[1] number of at least 40. Methanol has a very low cetane value (about 3 compared to #2 diesel fuel's cetane value of 45) and is, therefore, generally a poor fuel for use in conventional diesel engines.

Modifications can be made to the chemical nature of methanol fuel to make it compatible with diesel fuel and engines. Chemical additives can be mixed with it to increase its cetane value. However, according to experts in this area, the current cost of cetane enhancers is so great that such alterations to methanol fuel are uneconomic.

As noted, methanol can be blended with diesel fuel for use in conventional diesel engines, but the stability of the mixture is generally poor. Due to methanol's high octane and low cetane ratings, adding methanol to diesel fuel may not result in similar performance gains as experienced when mixing it with gasoline. In fact, it appears that in some instances, methanol/diesel mixing may have negative results. According to some analysts, at this time, the only real benefits of adding methanol to diesel for use in conventional diesel engines, may be to extend diesel supplies and to reduce particulate emissions. These benefits may, however, be at the cost of some loss in power, performance, and fuel efficiency. One transportation analyst stated that test results to date show that the mixture of methanol and diesel fuel performs as efficiently as a pure diesel fuel in current engines only at the lower range of power and speed, thereby severely limiting its use for some buses, trucks, and locomotives with diesel engines.

Modifications can be made to current diesel engines to burn higher methanol/diesel blends and neat alcohol. However, new engines that can burn alcohol are not yet completely proven and demonstrated as efficient and economically viable substitutes for conventional diesel engines. Test programs, however, are still underway in this area.

One potential method for modifying diesel engines to burn methanol is to install a fumigation system to spray methanol into the engine airtake system. This process allows use of methanol up to about 20 percent of the total fuel. A dual-fuel injection system could also be adapted. This would involve an engine with two completely separate fuel systems and storage tanks, with the diesel fuel serving as the fuel that ignites the methanol. By this method, methanol could constitute up to 90 percent of the fuel volume. This option would offer improved engine performance and maximize the use of methanol in diesel engines. However, the size, cost, complexity, and added weight of two fuel systems may make them impractical relative to current diesel engines. A third option would require such in drastic modifications to a diesel engine as to be virtually a new engine. These engines have yet to

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[1]Cetane value is a measurement of the ease with which a fuel will self ignite in air heated by compression; the higher the cetane number, the easier it is to start and maintain combustion.

be completely proven and demonstrated but may represent a way to use pure methanol and still maintain the efficiency of the diesel engine.

POTENTIAL FUTURE USES IN NEW ENGINES

When a viable methanol-burning substitute for diesel engines in heavy transportation uses is developed, demonstrated, and commercialized, the market potential for these engines in the United States could be quite large. They could be used in buses, trucks, and railroad transportation. Moreover trucks and buses usually have centrally located fueling stations (especially in the case of mass transit districts and larger trucking companies). Railroad uses may be somewhat less attractive.

In 1980, truck fleets in the United States amounted to a total of approximately 34 million vehicles. Estimates indicate that between 1980 and 2000 the total truck fleet will increase from 34 to 57.5 million vehicles for an average annual growth rate of 2.6 percent. Approximately 900,000 new trucks--both diesel and gasoline-powered--will be added each year. Sales of new diesel trucks in 1981 amounted to 209,000 and have averaged about 207,000 annually over the past 5 years. In addition, approximately 500,000 buses are now on the Nation's highways. Annual new bus sales have averaged about 32,000 over the past 5 years.

DOT stated that particular features of the railroad industry may limit the potential market for methanol in that industry. In 1980, 99 percent of locomotive units in service--a total of 28,483 out of 28,663 units--were diesel-electric units. Total replacement of locomotives on an annual basis averages only 3 to 4 percent of total units. Locomotives have a 15 to 18 year life cycle, with approximately 3 to 4 percent of the locomotives "remanufactured" (refurbished rather than replaced) at that time. Only 840 units (diesel-electric locomotive) were produced in 1981 in the United States, many of these for export. In a normal year, 600 to 800 units are built. This slow turnover of locomotives in the railroad industry, therefore, limits the likely number of new methanol powered locomotives that could be introduced each year. The industry, through the Association of American Railroads, is moving toward blending residual fuel with diesel to save money. But according to DOT officials, the industry is "not prone to risk taking." It is very capital intensive, and methanol engines--or any other innovation--must be well proven before the industry will accept it.

Specific technical problems with the fuel may further limit methanol's usefulness to the railroad industry. DOT officials told us that 300 gallons of methanol per hour would be required to run a locomotive. With a 4,500 gallon fuel tank on the locomotive, relative to diesel, methanol use would limit travel distances and result in fueling problems, according to these officials.

A representative of the Association of American Railroads told us that methanol can be used as an extender mixed with diesel

fuel, but it introduced technical problems for locomotives. Nevertheless, methanol's use as a 10 to 20 percent extender in railroad diesel would provide a potential market for methanol of 0.8 to 1.6 billion gallons per year (52,000 to 104,000 B/D). (The industry consumes 4-4.25 billion gallons of diesel fuel a year or 280,000 to 300,000 B/D.) However, fuel represents only 15 to 20 percent of total costs in the railroad industry (a relatively small percentage of total costs); modest savings in this area provide little motivation for the industry to use methanol as a fuel extender, according to DOT officials.

In summary, the replacement of diesel fuel with methanol--either as a fuel extender or substitute fuel in modified engines--is technically possible. An engine optimized for the use of methanol would likely be a lean burn, high-compression-return engine similar to a direct injection stratified charge engine. Some diesel engine modifications have moved in this direction, including adaptation of the German MANN engine. In the United States the White/Texaco and the Ford Proco engines are of similar configuration. As a diesel additive, the benefits of methanol beyond extending supplies and environmental benefits, are questionable. Firm conclusions as to the potential for methanol in a new engine for use in heavy duty transportation vehicles must await the demonstration of new engines, which are currently being tested and developed.

SOURCES OF METHANOL SUPPLY FOR THE TRANSPORTATION SECTOR

Methanol's potential as a substitute for insecure foreign oil is one of the principal reasons for the interest in it. However, if and when a market for methanol in the transportation sector arises, demand may not necessarily be met from domestic sources. Imports of methanol may increase.

Domestic production potential

In the foreseeable future, any methanol for fuel use in the United States is likely to come from natural gas and, to a very limited extent, from petroleum (probably less than 1 percent of all current domestic methanol). Methanol is currently produced from natural gas because the plants have lower capital costs than coal or biomass plants would, and natural gas has been a less expensive feedstock.

The production of methanol from abundant domestic supplies of coal is an attractive alternative to natural gas-based methanol. A full discussion of the economics of this aspect of the synfuels industry is beyond the scope of this report. Nevertheless, this process is undoubtedly highly capital intensive and no commercial-scale coal-to-methanol fuel facilities are currently in operation in the United States. Recent estimates indicate that a plant using coal as a feedstock could cost from 2.5 to 3 times more than a natural gas methanol plant. Current estimates indicate that facilities for manufacture of methanol from coal would account for

about 50 percent of the final fuel price. Creating a transportation and distribution system for methanol would add considerably to the price. Many analysts believe that, if driven purely by market economics, significant use of methanol fuel from coal will not occur in the near future.

Methanol from biomass, while technically proven, appears to be a very long-term option. The technology for making methanol from this source is not yet at an advanced stage of refinement, and the cost estimates of methanol from a commercial-scale facility are highly speculative. The current state of commercial development of methanol from coal and biomass facilities--and associated problems--suggests that in the foreseeable future-increased demand in the transportation sector will be met from natural gas-based methanol. However, over the next few years, domestic gas price decontrol is expected to increase the cost of domestic gas-based methanol. This trend will have an impact on the relative prices of domestic natural gas-based methanol vis-a-vis the price of domestic coal-based methanol and the price of foreign gas-based methanol, making both alternatives relatively more attractive.

Since methanol from foreign natural gas sources is currently less expensive than domestic coal-based methanol would be, an increase in the domestic methanol price may act to increase reliance on imported supplies.

Imports

The effects, if any, that imports of methanol may have on the creation of a methanol fuel market, and whether or not imports are favorable from a national security standpoint, are controversial issues. While the quantity of methanol presently imported into the United States under the tariff-free customs category designated for direct fuel use only is insignificant in comparison to total U.S. methanol production, these imports have increased markedly in 1982, and present indications are that this trend will continue. Table 10 illustrates methanol fuel import levels for recent years from "most favored nations."[2]

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[2]The term "most favored nation" is a designation assigned certain countries with which the United States trades and which receive certain favorable consideration by the U.S. in the course of trade relations. "Most favored nations" encompasses nearly all non-Communist countries. Under this customs category, methanol for fuel use from these countries may enter the U.S. duty-free.

Table 10

Imports of Methanol for Fuel Purposes

Year	Quantity (gal.)	Customs value	Average value per gallon	Source
1978	270	$ 1,000	-	-
1979	-	-	-	-
1980	28,661	$ 13,000	$ .45	-
1981	439,871	$351,836	$ .80	-
1982	8,676,237	$4,573,894	$ .53	Canada--8,376,237 gal. Libya-- 300,000 gal.

Source: U.S. Census Trade Information Office.

The increase in methanol imports has occurred despite a surplus of domestic methanol in 1982. According to industry spokesmen, the reason for this is a matter of geography and cost. The imports have been almost entirely from Canada into the U.S. northern tier States where it is used primarily as a gasoline octane enhancer. The majority of U.S. methanol production is situated along the Gulf Coast. Apparently, it is easier and less expensive to ship methanol to the northern States from Canada rather than from the Gulf Coast.

Major domestic producers of methanol foresee significant growth in demand for methanol in the short to medium term, especially for fuel uses (see table 11). Both Celanese and Dupont, which together account for about 60 percent of domestic methanol capacity, forecast that methanol demand will have outstripped domestic methanol capacity by 1985, and the United States will have to either increase domestic capacity or imports. This situation raises the possibility that, even in the short-term, some methanol for transportation uses may be imported rather than produced domestically. At present, increased methanol imports based on natural gas appear to be the most likely alternative because of anticipated cost advantages. Foreign natural gas feedstocks offer some price advantage, especially where substantial quantities of gas are presently being flared or reinjected, for lack of an available economical means of transport. Consequently, U.S. companies are beginning to invest in new, foreign methanol capacity rather than new, domestic capacity. For example, Celanese recently built a new 235 million gallon per year plant in Alberta, Canada's, gas fields. Some of this methanol is reportedly intended for export. Celanese is also participating in a joint venture, 220 million gallon per year natural gas-to-methanol plant in Saudi Arabia.

Table 11

U.S. Methanol End-Uses
(millions of gallons)

Chemical uses	1979	1980	1985	1979-1985 annual growth rate
				Percent
Total chemical demand	1,090	980	1,470	5
Fuel uses				
MTBE (Octane Enhancer)	5	30	165	79
Direct fuel	5	20	200	85
Total fuel demand	10	50	365	81
Total U.S. demand	1,100	1,301	1,835	8-9

Source: E.I. DuPont De Nemours & Co.

In the longer term, assuming that coal-based--and perhaps even biomass-based--methanol facilities are on line and the fuel is competitively priced with domestic gas-based methanol, imports may still be less expensive. This situation could occur if foreign gas, which would otherwise be flared, were used to produce methanol, or if the price of foreign supplies of methanol were intentionally kept low to undercut U.S. prices and to take advantage of U.S. markets.

Therefore, if methanol penetrates the transportation fuel market in the United States, the percentage of methanol fuel from foreign sources may increase as demand grows. This raises the question of whether establishment of a methanol fuel market in the United States may lead to increasing dependence on imported methanol supplies, rather than on domestic sources of energy.

Those in favor of methanol imports claim that they can be used to help create a market in the United States for fuel methanol. Those companies planning to produce and/or market methanol can theoretically use imports to provide, or augment, their supply of methanol upon which to build a distribution network, and obtain customers. Others fear that, if demand for methanol transportation fuel develops prior to developing longer-term indigenous supply sources (i.e., methanol from coal), foreign methanol production based for the most part on relatively inexpensive natural gas supplies could pose a threat to the potential viability of a domestic methanol fuel industry.

Depending on the pricing of the feedstock and the means of financing these projects, the product price could make coal-to-methanol projects in the United States uneconomic for the foreseeable future, and even reduce marginally economic natural gas-to-methanol production currently operating in the United States. Those opposing methanol imports believe that if the intent of methanol fuel use in vehicles is to enhance national security, clearly this purpose will not be served by substituting imported methanol for imported oil, especially if that methanol production capacity originates in OPEC countries. They also contend that the present tariff system which provides duty-free entry for methanol fuel, while levying an 18 cent per gallon duty on chemical grade methanol will force imported methanol into the fuel market. This situation, they contend, will make the establishment of a viable domestic methanol fuel production capability all the more difficult.

In considering the possible sources of methanol fuel for the transportation sector, it should be emphasized that supply from foreign sources rather than domestic sources does not necessarily present a supply security problem. While methanol from domestic sources may generally be preferable from an energy security standpoint, imported supplies are not necessarily insecure supplies. This determination depends on what the particular foreign source of the methanol is. We have not looked at the likely future foreign sources of methanol in any detail. However, based on the facts that the least expensive source of methanol is likely to be the preferable source in terms of costs, and that those foreign sources likely to be selling the least expensive methanol are those with surplus or flared natural gas supplies, we can identify several potential future sources of methanol imports. The most likely potential candidates could include: Canada (the U.S.'s largest current foreign methanol supplier); Libya (another recent supplier of U.S. methanol imports which is expanding its methanol production capacity by 8 MBD by 1984); Saudi Arabia (which flared 1,342 billion cubic in 1980 and will expand methanol capacity by 27 MBD by 1985); Nigeria (flared 1,014 billion cf), Iran (flared 558 billion cf), and Iraq (flared 431 billion cf). The lead-time for building a natural gas-to-methanol plant is about 4 years, so a project conceptualized today could not come on-line before 1987. The security of methanol imports will depend on the assessment of which of these--or other--suppliers are likely to be the most dependable.

CHAPTER 5

SUMMARY OF FINDINGS, OBSERVATIONS, AND AGENCY COMMENTS

SUMMARY OF FINDINGS

Based on our analysis of the institutional and infrastructural impediments to the commercialization of methanol as a transportation fuel, we have the following findings: The high initial cost of new supply and marketing requirements for methanol fuel and vehicles is the principal barrier to the development of a market for methanol fuel. However, there is little the Federal Government can do to directly attack these economic barriers, short of providing financial incentives or subsidies. The Federal Government may take other, less direct actions--such as adjustments to regulations--which may facilitate development of a market. Before any national commitment to actively promote methanol as an alternative fuel is made, however, the issue of potentially increased foreign supplies of the fuel and its possible implications should be considered.

Regulatory considerations affecting methanol fuel

Methanol's use in blends with unleaded gasoline is regulated by EPA. In order to be approved, blends must be tested to assure that they will not cause vehicles to violate motor vehicle emission standards under the Clean Air Act. Some fuel manufacturers have complained about the need to test each individual blend, considering this process to be costly and time consuming. However, these tests do not impose a serious impediment to methanol's marketing.

Vehicles running on neat methanol and specifically equipped or adjusted for its use normally meet established standards for carbon monoxide, hydrocarbon and nitrogen oxide emissions. However, EPA currently has no officially sanctioned certification procedures for vehicles designed to burn neat methanol. This absence leaves potential methanol vehicle producers uncertain as to what requirements will eventually have to be met.

The absence of an equivalency factor for comparing methanol vehicle fuel economy on an equal basis with that of vehicles running on other fuels for purposes of the Corporate Average Fuel Economy standards and vehicle labeling will likely have a negative effect on both the production and sale of methanol vehicles. A mechanism for establishing an equivalency factor exists under current legislation. However, neither DOT nor EPA acknowledge a need for developing a methanol fuel economy equivalency factor at this time. Early establishment of an equivalency factor--before a methanol fuel market develops--may, in fact, aid the development of the market.

Vehicle antitampering regulations, as presently administered by the EPA, do not pose any serious restrictions on the converting vehicles to burn methanol provided they comply with motor vehicle emission standards. Since tests indicate that vehicles altered to burn neat methanol would normally produce fuel emissions well within regulated levels, this regulation should pose no serious impediment to the methanol fuel market.

Antitrust laws may limit some specific cooperative activities considered by methanol fuel producers and vehicle manufacturers. However, uncertainty regarding the potential antitrust implications of collaboration between the industries can be eliminated or reduced by the industries'--or a trade organizations's--consultation with the Justice Department.

There are currently no standards or regulations in place governing potentially harmful aldehyde and unburned methanol fuel emissions from methanol. This absence of standards creates uncertainty and adds to the reluctance of investors to undertake necessary infrastructure investments.

Fleet use of methanol

Under favorable conditions, and assuming some motivation on the part of fleet operators to convert to methanol, captive fleet use of methanol could potentially lead to a wider market for methanol fuel and vehicles. The likelihood that this will occur, however, depends on the quantity and rate of methanol vehicle procurement, and what further actions are taken to make both fuel and vehicles available to the general public.

Although conversion of the Federal fleet to methanol use may have psychological benefits in the sense that it would connote Government endorsement of methanol fuel, Federal fleet use alone would not provide a sufficient market to promote more widespread use of the fuel and vehicles.

Sources of methanol

If and when demand for methanol in the transportation sector increases, the likely short-term source of supply will be methanol from natural gas. Presently, methanol from natural gas is commercially available and economics favors its production relative to coal and biomass-based methanol. In the longer term as oil and petroleum-based products became more expensive, these relative positions may be reversed, but it is unclear at what point this will occur. In the meantime, however, most methanol fuel will be produced from natural gas. Methanol produced from some foreign sources of natural gas may be less expensive than domestic natural gas based methanol. This price difference is expected to continue and, perhaps, grow. Therefore, for the foreseeable future, the likely source of increased amounts of methanol fuel to meet potentially expanded needs in the transportation sector will be probably natural gas. Foreign sources may supply increasing amounts of methanol fuel.

OBSERVATIONS

We have identified certain steps that the Federal Government could take to facilitate development of a methanol fuel market. These steps are:

--Develop standards and regulations for aldehyde and unburned methanol emissions associated with methanol fuel before a market arises and the technical need for such standards becomes evident. Such action by EPA would help remove some of the uncertainty which is constraining investments. Consideration could also be given to developing standards for evaporative emissions.

--Develop, in cooperation with the American Society for Testing and Materials (ASTM) and similar organizations, specifications and standards specifically governing the production, storage, and use of methanol fuel. The precedent for standard setting by the Department of the Army, the General Services Administration, and subsequent adaptation by private industry has been established.

--Establish an equivalency factor for comparing methanol vehicles' fuel economy with that of vehicles running on other fuels on a common basis before a market arises. Both the mechanism and the precedent have been established for EPA and DOT taking this action.

--EPA, with the help of trade associations, could determine the maximum level of methanol (either without cosolvents or with known cosolvents) that, when blended with unleaded gasoline, will not violate emission standards or damage vehicle fuel systems. A "blanket" waiver for methanol blending could then be granted.

--Issuance of such a blanket waiver might require industry cooperation, in that producers might have to reveal more about the chemical composition of the blend than has previously been necessary.

Because of the availability of low priced foreign methanol supplies, the development of a methanol market in the transportation sector will not necessarily help to reduce our reliance on foreign energy sources--at least in the short-term. This would be a relevant consideration to any decision to promote methanol as a domestically produced alternative fuel to enhance national security.

AGENCY COMMENTS

The Departments of Energy, Justice, and Transportation; the Environmental Protection Agency; and the General Services Administration commented upon a draft of this report. These

comments are included in appendix III. In general, they agreed with the findings of this report. We made certain observations on steps that the Government could take to remove barriers to methanol's commercialization. Agency comments broadly supported these. Editorial suggestions have been incorporated in the report, where appropriate.

DOE made the relevant point that a volumetric tax on methanol as a fuel constitutes a potential barrier to increased methanol use because methanol contains less energy by volume.

DOE gives greater emphasis to potential antitrust problems than does the report. We believe that until existing antitrust remedies available through the Department of Justice have been tried, it is too early to conclude that they are inadequate. DOE also took issue with our view that imported methanol may help to meet increased domestic demand from the transportation sector in the near- to mid-term on the grounds that foreign demand may also increase. Potential foreign demand might well increase; we did not examine this subject in detail. However, large quantities of natural gas continue to be flared in major foreign oil producing countries. This fact suggests that the potential for natural gas-based methanol production overseas is high. Therefore, increased U.S. demand for methanol fuel may result in larger methanol imports because foreign producers are likely to have access to low cost feedstock and to produce methanol less expensively. Domestic coal-to-methanol production could arise in the longer term.

The Department of Transportation suggested that we more extensively address possible safety hazards of methanol fuel use. Methanol fuel use presents several safety related trade-offs compared to gasoline. In the open air, neat methanol (above 85 percent pure) is considered less dangerous than gasoline. On the other hand, as Department of Transportation points out, methanol vapor in a vehicle tank may be an increased fire hazard. Low percentage methanol blends seem to present no special safety hazards. We discussed this issue in greater detail in chapter 2.

The General Services Administration recommended a more extensive discussion of engine and fuel compatibility problems. As we noted in chapter 1, methanol fuel may require substantial modifications to existing gasoline vehicle engines and fuel systems. Furthermore, differences in combustion characteristics between methanol and gasoline prevent the use of one of these fuels in a vehicle designed or modified to use the other.

The comments of the Department of Justice and the Environmental Protection Agency are clarifying and have been incorporated.

APPENDIX I

U.S. HOUSE OF REPRESENTATIVES
SUBCOMMITTEE ON FOSSIL AND
SYNTHETIC FUELS
COMMITTEE ON ENERGY AND COMMERCE
WASHINGTON, D.C. 20515

April 28, 1982

The Honorable Charles A. Bowsher
Comptroller General of the United States
General Accounting Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Bowsher:

As Chairman of the House Subcommittee on Fossil and Synthetic Fuels, I am deeply concerned that the United States' continued reliance on imported oil supplies from potentially unstable sources leaves our Nation vulnerable to supply disruption and threatens our economy and security.

Although U.S. reliance on imported oil supplies has declined in recent months as a result of decreasing domestic consumption, our dependence on imported oil and our subsequent vulnerability to supply disruptions are likely to remain high. According to recently released 1980 census data, two-thirds of American workers drive to work <u>alone</u> every day and the number of people using public transportation has dropped to 1 in 16 despite two fuel short periods since the last census, when the figure was 1 in 12. Therefore, the development of viable domestic alternatives to liquid fuels for automotive and other uses will continue to be of critical importance.

Methanol (which can be produced from natural gas, coal or biomass) already has been demonstrated to be technically and economically viable. It can be used directly as an automotive fuel or blended with gasoline or diesel oil. The Office of Technology Assessment is presently evaluating the state of technology for energy use in the transportation sector. While the OTA study isn't finished yet, preliminary indications are that it will also conclude that the technology for the use of methanol is available. The OTA study indicates that the principal obstacles to the widespread production and use of methanol as an alternative to gasoline are institutional.

APPENDIX I

It appears that we may be faced with a "chicken and egg" situation. Automobile manufacturers indicate they would produce cars to use methanol if the infrastructure were in place to fuel and service them. Sellors of fuel, on the other hand, state that there is no market for methanol at the present time. Similar difficulties seem to impede the rapid adoption of methanol for other uses in the transportation sector. This issue may have fundamental implications for national energy policy. Your Energy Policy and National Security Group could make a valuable contribution to this Committee by identifying the institutional and infrastructural barriers to methanol's market penetration and objectively defining and assessing alternative policy options available to the Government to overcome these barriers. In view of the current budgetary situation, I prefer that you emphasize those alternatives which would involve little or no increased Government expenditures.

Specifically, I would like GAO to:

-- identify and assess the infrastructural and institutional barriers to methanol's market penetration as a substitute for gasoline as a transportation fuel, and

-- examine possible policy options available to the U.S. Government to achieve increased use of methanol, discussing and analyzing the advantages and disadvantages of each and their likely economic and energy consequences.

I would like to review your results by early August to assist in setting the basis for hearings we have tentatively scheduled on the subject at that time. The final report can be delivered subsequent to the hearing. I hope that members of the Energy Policy and National Security Group will keep in close contact with Committee staff, Steve Kilbuck and Roger Staiger, in developing plans for this report.

Sincerely,

Philip R. Sharp
Chairman

PRS:sk

LIST OF GAO REPORTS ADDRESSING

ALCOHOL FUELS AND RELATED ISSUES

"Potential of Ethanol As a Motor Vehicle Fuel" (EMD-80-73, June 3, 1980).

"Concerns Over the Department of Energy's (DOE's) Program and Organization for Developing and Promoting the Use of Alcohol Fuels" (EMD-80-88, July 22, 1980).

"Conduct of DOE's Gasohol Study Group: Issues and Observations" (EMD-80-128, Sept. 30, 1980).

"DOE's Alcohol Fuels Awards Process Resulted in Questionable Award Selections and Limited Small Business Success" (EMD-81-125, Aug. 21, 1981).

"Earlier Effective Monitoring of Alcohol Fuels Projects May Have Minimized Problems" (EMD-82-42, April 23, 1982).

"Assessing the Feasibility of Converting Commercial Vehicle Fleets to Use Methanol as an Offset in Urban Areas" (PAD-82-39, June 11, 1982).

APPENDIX III

Department of Energy
Washington, D.C. 20585

JUL 14 1983

Mr. J. Dexter Peach
Director, Resources, Community and
Economic Development Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Peach:

The Department of Energy (DOE) appreciates the opportunity to review and comment on the GAO draft report entitled "Removing Barriers to the Market Penetration of Methanol Fuels." DOE believes that a sound Federal approach and policies that permit new liquid fuels to penetrate the market are essential to reduce the negative impact of potentially unstable foreign supplies of petroleum. The draft GAO report identifies the key barriers to the commercialization of methanol as a transportation fuel and suggests options for Federal action to remove them. DOE agrees in general with the basic findings that are presented in the draft report. However, there are additional considerations beyond those discussed in the report that indicate the Federal actions which may be warranted.

The report addresses the limitations imposed by antitrust regulations on cooperative actions of fuels producers and vehicle manufacturers. We have been told by industry sources that these limitations, in combination with the principal barrier of economics, pose a considerably greater impediment than that conveyed by the report. One risk, untenable to all parties, is that of moving ahead independently. Actions taken in concert, necessary to establish a common methanol production/distribution/utilization infrastructure, face penalties from violation of antitrust regulations. Although Government cooperation, such as permission of the Department of Justice to carry out certain actions under a Business Review Letter, offers some degree of relief, it may not assure protection against civil law suits. These factors give rise to an "atmosphere of uncertainty" correctly identified by the GAO report, and constitute a significant barrier. A mechanism is needed for the automobile, fuels, and chemical industries to cooperate in the development of specifications which would assure both fuel fungibility and compatibility with fuel transport, storage, and utilization equipment, while still protecting the public against abuse of the competitive system. This will permit assurances that the public will not undergo and/or absorb the risks associated with incompatible fuel supplies from various fuel retailers, with differing fuel requirements from competing automobile manufacturers, or with vehicles becoming obsolete as a result of subsequent changes in fuel formulation.

The known mechanisms, including those identified in the report, fall short of permitting such cooperative efforts.

Taxation of fuel on a volumetric basis constitutes a serious potential barrier to methanol use, since methanol has only half the energy per unit volume of gasoline. Experts and analysts in this field have long agreed that taxation on an energy basis (or equivalent adjustment) is essential to economic viability of neat methanol.

With regard to sources of methanol supply, the GAO draft report repeatedly points out that present supply comes from natural gas, and that the world market is currently characterized by surplus stocks of both natural gas and methanol. However, the report unduly emphasizes these present and near term surpluses. Whereas the surplus of methanol is large in respect to the chemical market, the total is small relative to fuel energy use. Further, it must be recognized that there is widespread international interest in methanol as a fuel. Interest within various countries stems from a combination of the existing need to import petroleum and the desire to maintain stable petroleum prices by managing or avoiding the relatively minor perturbations in petroleum supply that significantly affect fuel prices. The domination of the market by imported methanol envisioned by the GAO draft report would be mitigated by parallel development of foreign methanol fuel demand, recovery of the true value of presently flared gas, influence of methanol transportation costs, and the U.S. gas industry's perceived need for new natural gas markets.

Another factor affecting the competition between foreign and domestic supply is that within a few years it will be essential for natural gas to be taken from the North Slope. At least one major U.S. petroleum supplier is seriously investigating this as a source of methanol fuel to replace the void which will develop from dwindling production of North Slope oil circa 1990. It should also be noted that present actions under consideration by the U.S. Synthetic Fuels Corporation include potential support of projects to produce methanol from peat and coal. In any case, the establishment of a methanol fuels market based on current and near term supplies would facilitate long term actions to substitute domestic coal-based methanol for increasingly scarce supplies of imported petroleum. From the combination of these factors, it may be conceived that temporary international surpluses of methanol might be used as a mechanism to overcome "the chicken or the egg" problem alluded to by the GAO draft report.

DOE agrees that the only significant Federal option for methanol/gasoline blends other than incentives is that of delineating emissions tests and certification requirements and granting a blanket fuel waiver on a basis that will reduce industry uncertainties. This must, however, include appropriate consideration of evaporative emissions requirements which were arbitrarily drawn up based on gasoline fuel. Similar delineation of the treatment of emissions from neat methanol is also endorsed.

APPENDIX III

Comments of an editorial nature have been provided directly to members of the GAO audit staff. DOE appreciates the opportunity to comment on this draft report and trusts that GAO will consider the comments in preparing the final report.

Sincerely,

Martha O. Hesse
Assistant Secretary
Management and Administration

APPENDIX III

U.S. Department of Transportation

Assistant Secretary for Administration

400 Seventh St., S.W. Washington, D.C. 20590

JUL 20 1983

Mr. J. Dexter Peach
Director, Resources Community and
Economic Development Division
U. S. General Accounting Office
Washington, D. C. 20548

Dear Mr. Peach:

Enclosed is our response to your letter requesting Department of Transportation (DOT) comments on the General Accounting Office (GAO) draft report, "Removing Barriers to the Market Penetration of Methanol Fuels", dated June 6, 1983.

GAO examines impediments to the establishment of methanol as a commercially viable transportation fuel.

The economics of establishing a methanol fuel market pose a substantial barrier to methanol's commercialization. GAO found that there are certain Federal regulations which may present additional, though less important, impediments to a methanol fuel market. Unlike the economic barriers, these regulatory factors are within the control of the Federal Government. Therefore, the Government could make changes which might be effective at the margin--that is, they would not in themselves create a broad market for methanol, but they might help.

GAO notes that because of the availability of low priced foreign methanol supplies, the development of a U.S. methanol fuel market will not necessarily help to reduce our reliance on foreign energy sources--at least in the short term. This consideration is relevant to any decision to promote methanol as a preferred alternative fuel.

The report correctly describes and characterizes the National Highway Traffic Safety Administration's (NHTSA) position regarding the designation of methanol or methanol-gasoline mixtures as "fuel" under the provisions of the fuel economy regulatory program of Title V, Motor Vehicle Information and Cost Savings Act. Thus far, NHTSA has taken the position that to make such a designation and thereby bring the manufacturers of vehicles fueled by methanol or methanol-gasoline mixtures under the fuel economy regulations would simply impose an unnecessary and counterproductive regulatory burden on such manufacturers.

It would be appropriate if the GAO report would address more extensively the hazards of using methanol as a motor vehicle fuel. For instance, the

APPENDIX III

Society of Automotive Engineers points out in its Standard SAE J1297 that "Saturated vapor in a liquid methanol or ethanol tank is flammable, so increased fire hazard may be expected."

If we can further assist you, please let us know.

Sincerely,

Robert L. Fairman

Enclosure

APPENDIX III

General Services Administration Washington, DC 20405

JUL 8 1983

Honorable Charles A. Bowsher
Comptroller General of the United States
U. S. General Accounting Office
Washington, DC 20548

Dear Mr. Bowsher:

Thank you for the opportunity to comment on the GAO draft report entitled, "Removing Barriers to the Market Penetration of Methanol Fuels (GAO/RCED-83-71)."

The report is very comprehensive and we would like to offer the following suggestions to enhance the final report and aid the reader in understanding the complexities involved in the methanol issue.

1. Expand the discussion of vehicle conversion. Even though the report properly focuses on institutional and policy issues as requested by the Committee on Energy and Commerce, it would greatly benefit from a more intensive assessment of compatibility problems; i.e., operating a gasoline engine on methanol blends or operating an engine designed for methanol use on gasoline. This is significant since the Committee's request indicates methanol has already been demonstrated to be technically and economically feasible and readers might be inclined to underestimate the compatibility problems and associated expenses which are only lightly touched on in the draft. Further insight on this issue can be provided by the major automobile manufacturers.

2. Include explanations of terms such as alcohol, methanol, ethanol, gasohol, blends, etc., which are frequently misunderstood.

3. Include a bibliography showing the wide range of input sources that were used in developing the report.

Sincerely,

Ray Kline
Deputy Administrator

APPENDIX III

U.S. Department of Justice

July 14, 1983

Washington, D.C. 20530

Mr. William J. Anderson
Director
General Government Division
United States General Accounting Office
Washington, D.C. 20548

Dear Mr. Anderson:

This letter is in response to your request to the Attorney General for the comments of the Department of Justice (Department) on your draft report entitled "Removing Barriers to the Market Penetration of Methanol Fuels."

This draft report examines impediments to the establishment of methanol as a commercially viable transportation fuel and identifies certain steps that could be taken by the Federal Government to facilitate development of a methanol fuel market. As to the economics of establishing a methanol fuel market, the Department defers comment to those interested agencies mentioned in the report who are familiar with the issues raised. The Department's comments concern primarily the Antitrust Division's statement on page 34 and GAO's referral to antitrust laws as a form of regulation.

Page 34 of the report includes a statement attributed to an official of the Antitrust Division concerning the fears that cooperation between methanol producers and vehicle manufacturers might subject one side or both to antitrust charges. The context of the statement is misleading and a corrected version for use in the report is provided:

> To date, the Antitrust Division of the Department of Justice has not commented on the development of any new transportation fuel or any potential antitrust concerns surrounding proposed linking of the fuel producing and consuming ends of the industry. Although the Department of Justice is not authorized to give advisory opinions to private parties, the Antitrust Division does, in certain instances, review proposed business conduct and make known the Department's intentions regarding enforcement of antitrust statutes. (See 28 CFR § 50.6)

Throughout the report, the antitrust laws are referred to as a form of regulation. To give such an impression is misleading, and we are offering suggested revisions on the pages cited below to eliminate our concern:

Page iii, Third Side Caption

Change "Antitrust regulations" to read "Antitrust."

See GAO note, p. 67.

APPENDIX III

Page iii, Third Paragraph, First Line

Change "regulations" to read "considerations."

Page 11, Second Paragraph, Line 9

Delete the words "and regulations."

Page 24, Line 7

Delete the words "and regulations."

Page 24, Third Full Paragraph First Full Sentence

Revise to read: "Based on our review of statutes and regulations potentially bearing on methanol fuels, we found that, in general, these statutes and regulations do not constitute major barriers to the establishment of a market. Some of these statutes and regulations may . . . ."

Page 25, Line 6

Add the words "statutes and" after the word "Federal."

Page 51, Second Paragraph, First Line

Change "regulations" to read "laws."

We appreciate the opportunity to review and coment on the report. Should you desire to discuss any aspects of our response, please feel free to contact me.

Sincerely,

Kevin D. Rooney
Assistant Attorney General
for Administration

APPENDIX III

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

[redacted]

OFFICE OF
POLICY AND RESOURCE MANAGEMENT

Mr. J. Dexter Peach
Director
Resource, Community and Economic
Development Division
United States General
Accounting Office
Washington, D.C. 20548

Dear Mr. Peach:

The Environmental Protection Agency (EPA) has reviewed the General Accounting Office (GAO) draft report "Removing Barriers to the Market Penetration of Methanol Fuels" (GAO/RCED-83-71). Public Law 96-226, as you know, requires the Agency to review and comment on the draft report.

Enclosed are EPA's technical comments on the report. I trust that GAO will consider EPA's views during its review prior to publishing the final report.

We appreciate the opportunity to review this report.

Sincerely,

Joseph A. Cannon
Associate Administrator
for Policy and Resource Management

Enclosure

APPENDIX III

EPA's Comments on the GAO
Draft Report "Removing Barriers
to the Market Penetration of Methanol Fuels"

- Page ii, last paragraph. The first two sentences imply that gasoline and diesel-fueled vehicles do not emit aldehyde emissions. This is wrong. Past and present gasoline and diesel-fueled vehicles do emit aldehydes. The important point is that methanol-fueled vehicles emit higher levels of aldehydes.

- Page 6, first full paragraph. Replace last two words, "available devices" with "catalytic aftertreatment".

- Page 6, second full paragraph. Here and in a few other places where blends are judged to be "acceptable" it should be emphasized that EPA has always required co-solvents (higher alcohols) which prevent phase separation of the methanol blends.

- Pages 6, 7, 9. There is no discussion of evaporative emissions, which is probably the most significant environmental concern of methanol blends, at least for blends up to 10 or 15 percent.

- Page 11. Under the section "Restrictions Under the Clean Air Act," the subheading should read "Motor vehicle emission standards and requirements," instead of "Fuel emission...." Similarly, the paragraph following should begin, "Current motor vehicle emission standards...." The phrase "Fuel emission standards" is wrong and is repeated throughout the report on pages including 12, 16, 18, 19, 24, 34, 50, and 51.

- Page 12. The characterization of the waiver requirements of section 211(f) of the Clean Air Act as a "regulation" is inaccurate -- the requirements are statutory. The distinction is a material one, since to the extent readers of the report believe those requirements should be changed, changes would have to come from Congress, not EPA.

- **Page 12, third full paragraph; Page 13, Second paragraph; and Page 24, fourth full paragraph. The report implies** that any blend with less than 12 percent methanol is acceptable. EPA has only approved one blend with this high a methanol content, and it had co-solvents and other proprietary compounds. In addition, that waiver approval is now being legally challenged by the automotive industry. It is not clear at this time what an "acceptable" level is. Specifically, in the last paragraph on page 13, we recommend that the clause beginning with "currently it appears..." be deleted and substituted with "there is a general consensus that methanol levels of up to 5% with consolvents are acceptable and that blends with methanol levels greater than 12% are unacceptable. There is much disagreement over the desirability of blends containing between 5% and 12% methanol."

- **Pages 12 and 13.** The discussion of the status of the Anafuel waiver is out of date, and should reflect EPA's recent initiation of proceedings to reconsider the waiver (48 Federal Register 19779 [May 2, 1983]). Reconsideration of the waiver calls into question the conclusions, on **pages 13 and 24,** that blends of up to 12 percent methanol present no emission problems.

- **Page 15, first full paragraph.** It would be more precise to substitute "formaldehyde" for "aldehydes" since most health effects testing has involved formaldehyde and it is the principal aldehyde in methanol-fueled vehicle exhaust.

- **Page 17,** last paragraph. "Field Operations and Support Division".

- **Page 18.** The draft report states that EPA has proposed tampering regulations. In fact, the Agency has published only an advance notice of proposed rulemaking addressing, among other matters, whether regulations are necessary or appropriate.

- **Page 34, last paragraph.** Methanol does not burn "poorly" in low-compression cars, it is considered to be an acceptable fuel in such engines. Rather it burns more efficiently in high-compression engines.

- **Page 50.** The first sentence under the heading "Regulatory Considerations Affecting Methanol Fuel" is confusing. Also, the statement later in that paragraph, that vehicles running on neat methanol "still must be tested," is inaccurate. As the draft report correctly observes, on pages 14-16, EPA currently has no standards or test procedures for vehicles designed to burn neat methanol.

GAO note: Page references in this appendix have been changed to correspond to page references in final report.

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